THE

CABINET-MAKER

AND

UPHOLSTERER'S

DRAWING-BOOK.

IN THREE PARTS.

THOMAS SHERATON,

CABINET-MAKER.

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STREET, GROSVENOR-SQUARE.

1793.

CONTENTS OF THE THREE PARTS.

PART I.

Containing ſuch Geometrical Lines and Inſtructions as are highly uſeful to Perſons of both Branches, illuſtrated in Seven Copper-plates. To which are added the Five Orders, exhibited in five different Plates, proportioned by Modules, Minutes, and Aliquot Parts, according to the moſt approved Authority; together with ſome Account of their Antiquity and Origin.

PART II.

On Practical Perſpective, applied to the Art of repreſenting all Kinds of Furniture in different Situations; interſperſed with ſomething of the Theory, for ſuch as would know the Principles on which this uſeful Art is founded. The Whole illuſtrated in Thirteen Copper-plates.

PART III.

A Diſplay of the preſent Taſte of Houſehold Furniture; containing alſo uſeful Remarks on the manufacturing Part of difficult Pieces. To which are added, ſome Cornices drawn at large; the Method ſhewn of Gaging, Working, Contracting, and Enlarging of any Kind; together with two Methods of repreſenting a Drawing-Room.

DIRECTIONS for finding and binding in the PLATES, with an Account of their CONTENTS.

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LIST OF SUBSCRIBERS.

In the following Liſt it is to be obſerved, that the Maſters in London are diſtinguiſhed by having the Names of the Streets, and ſometimes the Number of the Houſe, affixed; but with reſpect to Maſters out of London and its vicinity we could not make this diſcrimination, and therefore we hope, on this account, to be excuſed by thoſe who reſide in the country.

A.

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N.

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Newton, Engraver, Thornhaw-ſtreet, Lon.
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Ormandy Richard, Whitehaven
Okely, Upholſterer, St. Paul's Church-yard

P.

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Penton, Braſs-founder, ditto
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Pettit, Cabinet-maker, Brewer-ſtreet, ditto
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Potter James, Cabinet-maker, ditto
Phelps Wm. Cabinet-maker, ditto
Philips, Carpenter, Mount-ſtreet, ditto
Prickett, Cabinet-maker, Foſter-lane, ditto
Peck Wm. Cabinet-maker, ditto
Proud Wm. Cabinet-maker, ditto
Pendrill Richard, Cabinet-maker, ditto
Potts, Cabinet-maker, Compton-ſtreet, ditto
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Peacock
Partridge, Cabinet-maker, ditto
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Pointer William, Leeds
Peters George, Cabinet-maker, London
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Potts, Whitehaven
Playſted, Upholſterer, London
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Park, Cabinet-maker, Hallifax
Parlby, Cabinet-maker, London
Perry, Upholſterer, ditto
Procter, Newcaſtle
Pickering, Cabinet-maker, London

Q.

Quick, Cabinet-maker, Tiverton

R.

Ramſay J. Eſq. London
Robins J. Cabinet-maker, Chancery-lane, do.
Reeder, Cabinet-maker, Oxford-ſtreet, ditto
Rawlins Philip, Turner, No. 173, Drury-lane

Rawlins, Bedftead-manufacturer, Theobald's road, London
Rutherford, Cabinet-maker, Hull
Rifhforth, Mufical-inftrument maker, Lon.
Randell J. Tottenham-court-road, ditto
Richards, Copperplate-printer, No. 98, Long-acre, ditto
Redford, Cabinet-maker, ditto
Robinfon George, Upholfterer, ditto
Rofs John, Cabinet-maker, ditto
Robinfon Thomas, Cabinet-maker, ditto
Robertfon Jofiah, Cabinet-maker, ditto
Robinfon Ifaac, Cabinet-maker, ditto
Robfon Thomas, Cabinet-maker, ditto
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Raw, Great Marlborough-ftreet, ditto
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Reid Peter, Grocer and Tea-dealer, Whitehaven
Rothery, Cabinet-maker, London
Rowatt, Hamilton
Riland, Cabinet-maker, Oxford-ftreet, Lon.
Richardfon, Cabinet-maker, ditto

S.

Smirke, Painter, Charlotte-ftreet, London
Seddons Tho. Upholfterer, Dover ftreet, ditto
Stone, Cabinet-maker, Houndfditch, ditto
Small, Cabinet-maker, Piccadilly, ditto
Smart, Drawing-mafter, Weftmoreland-buildings, ditto
Smallwood, Birmingham
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Shepherd Thomas, Cabinet-maker, ditto
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Simpfon Wm. Cabinet-maker, ditto
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T.

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U.

Udall Jacob, Derby

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White, Upholfterer, ditto
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Y.

Young, Trotter, and Hamilton, Cabinet-makers, Edinburgh
Yates John, Sheffield
Yates, ditto

Z.

Zeitler I. London

TO

CABINET-MAKERS AND UPHOLSTERERS

IN GENERAL.

GENTLEMEN,

I PRESUME, that to publiſh a Drawing-book anſwerable to the preceding title page will not require many words to convince you either of the neceſſity or propriety of the attempt.

Nor will it be requiſite to uſe an oſtentatious preface to recommend it to your notice, or to perſuade you of the utility of ſuch an undertaking. Therefore, what I have further to ſay in this Addreſs ſhall be to give ſome account of my plan, and point out to you the difference between this and other books which have been publiſhed for the aſſiſtance and uſe of Cabinet-makers and Upholſterers.

Books

Books of various deſigns in cabinet work, ornamented according to the taſte of the times in which they were publiſhed, have already appeared. But none of theſe, as far as I know, profeſs to give any inſtructions relative to the art of making perſpective drawings, or to treat of ſuch geometrical lines as ought to be known by perſons of both profeſſions, eſpecially ſuch of them as have a number of men under their directions. Nor have theſe books given accurate patterns at large for ornaments to enrich and embelliſh the various pieces of work which frequently occur in the cabinet branch. Such patterns are alſo highly neceſſary to copy from by thoſe who would ſufficiently qualify themſelves for giving a good ſketch, or regular drawing, of any thing they meet with, or are required to draw for others. It is granted that there are books of ornaments already publiſhed ſufficient for the above ends; but it may alſo be obſerved, that thoſe ornamental books which are good, are very extenſive, and of courſe very expenſive: on the other hand, thoſe that are cheap are either ſo ſmall and ill drawn, or ſo deficient through brevity, or want of examples, as to render them of little uſe to the learner. Beſides, were there no other reaſon for introducing ornaments into the following work, but the convenience of having a few good examples of this kind always at hand and ready to copy from, it would be ſufficient to juſtify the attempt. Nor indeed would this performance anſwer ſo well to the title of a Drawing-book without them. I hope,

therefore,

therefore, that it will be conſidered as an enhancement to the real value and uſefulneſs of the Cabinet-maker and Upholſterer's Drawing-Book to compoſe and ſelect ſome examples of ſuch ornaments as ſhall ſerve, both for the purpoſe of the learner, and alſo to aſſiſt the ideas of thoſe who have occaſion to adorn their work in this way.

As I have alluded to ſome books of deſigns, it may be proper here juſt to ſay ſomething of them. I have ſeen one which ſeems to have been publiſhed before Chippendale's. I infer this from the antique appearance of the furniture, for there is no date to it; but the title informs us that it was compoſed by a ſociety of Cabinet-makers in London. It gives no inſtructions for drawing in any form, but we may venture to ſay, that thoſe who drew the deſigns wanted a good ſhare of teaching themſelves.

Chippendale's book ſeems to be next in order to this, but the former is without compariſon to it, either as to ſize or real merit. Chippendale's book has, it is true, given us the proportions of the Five Orders, and lines for two or three caſes, which is all it pretends to relative to rules for drawing: and, as for the deſigns themſelves, they are now wholly antiquated and laid aſide, though poſſeſſed of great merit, according to the times in which they were executed. But it may here be re-

marked

marked to his credit, that although he has not given rules for drawing in * perſpective himſelf, yet he was ſenſible of their importance and uſe in deſigning, and therefore he ſays in his preface: "Without ſome knowledge of the rules of perſpective, the cabinet-maker cannot make the deſigns of his work intelligible, nor ſhew, in a little compaſs, the whole conduct and effect of the piece. Theſe therefore, referring to architecture alſo, ought to be carefully ſtudied by every one who would excel in this branch, ſince they are the very ſoul and baſis of his art."

After Chippendale's work there appeared, in the year ſixty-five, a book of deſigns for chairs only, though it is called "The Cabinet-maker's real Friend and Companion," as well as the Chair-maker's. This publication profeſſes to ſhew the method of ſtriking out all kinds of bevel work, by which, as the author ſays, the moſt ignorant perſon will be immediately acquainted with what many artiſts have ſerved ſeven years to know.

* This is ſtrictly true of the third edition of Chippendale's book; but the firſt edition of it, printed in 1754, has given two chairs, a dreſſing table, and a book-caſe in perſpective, ſhewing the lines for drawing them. But why theſe examples were not continued in the ſucceeding editions I know not. In the laſt edition of any work, we naturally expect to ſee it in its beſt ſtate, having received its laſt reviſal from the author, or ſome other hand equal to the taſk; and therefore it can never be thought unfair for a reader to form his judgment of a book from the laſt impreſſion. I hope, therefore, this will ſufficiently apologize for the above obſervation.

know. But this aſſertion both exceeds the bounds of modeſty and truth, ſince there is nothing in his directions for bevel-work, which he parades ſo much about, but what an apprentice boy may be taught by ſeven hours proper inſtructions. With reſpect to the geometrical view of the Five Orders which he has given, theſe are uſeful, and the only thing in his book which at this day is worth notice, as all his chairs are nearly as old as Chippendale's, and ſeem to be copied from them.

The ſucceeding publication to this ſeems to be Ince's and Mayhew's Book of Deſigns in Cabinet and Chair Work, with three plates, containing ſome examples of foliage ornaments, intended for the young deſigner to copy from, but which can be of no ſervice to any learner now, as they are ſuch kind of ornaments as are wholly laid aſide in the cabinet branch, according to the preſent taſte. The deſigns in cabinets and chairs are, of courſe, of the ſame caſt, and therefore have ſuffered the ſame fate: yet, in juſtice to the work, it may be ſaid to have been a book of merit in its day, though inferior to Chippendale's, which was a real original, as well as more extenſive and maſterly in its deſigns.

In looking over Ince's book I obſerved two card-tables with ſome perſpective lines, ſhewing the manner of deſigning them. Theſe, ſo far as they go, are a uſeful attempt; but cer-

tain it is to me, from ſome experience in teaching, that no perſon can have the ſmalleſt acquaintance with the principles of perſpective, merely from ſeeing two or three lines joined to a plate, without proper inſtructions by letter-preſs. It is true, a deſcription is given of theſe lines in the 7th page of his book, but not equal to what is abſolutely requiſite to ſuch as have no previous acquaintance with the art; and thoſe that have, will not require that which can give them no aſſiſtance. Properly ſpeaking then, what is done in this book, relative to perſpective lines, can only ſerve as a hint to the workman, that this art is eſſential in deſigning.

In the year 1788 was publiſhed, " The Cabinet-maker's and Upholſterer's Guide." In which are found no directions for drawing in any form, nor any pretenſions to it. The whole merit of the performance reſts on the deſigns, with a ſhort deſcription to each plate prefixed. Some of theſe deſigns are not without merit, though it is evident that the perſpective is, in ſome inſtances, erroneous. But, notwithſtanding the late date of Heppelwhite's book, if we compare ſome of the deſigns, particularly the chairs, with the neweſt taſte, we ſhall find that this work has already caught the decline, and perhaps, in a little time, will ſuddenly die in the diſorder. This inſtance may ſerve to convince us of that fate which all books of the ſame kind will ever be ſubject to. Yet it muſt be owned, that books

of

of this ſort have their uſefulneſs for a time; and, when through change of faſhions they are become obſolete, they ſerve to ſhew the taſte of former times.

I ſhall now conclude this account of books of deſigns with obſerving, that in the ſame year was given a quarto book of different pieces of furniture, with the Cabinet-maker's London Book of Prices; and, conſidering that it did not make its appearance under the title of a Book of Deſigns, but only to illuſtrate the prices, it certainly lays claim to merit, and does honour to the publiſhers. Whether they had the advantage* of ſeeing Heppelwhite's book before theirs was publiſhed I know not; but it may be obſerved, with juſtice, that their deſigns are more faſhionable and uſeful than his, in proportion to their number.

Upon the whole then, if the intended publication, which now petitions your patronage and ſupport, be ſo compiled and compoſed as fully to anſwer, and alſo to merit, the title which has been given to it, I think it will be found greatly to ſupply the defects of thoſe books now mentioned, and will appear to

* This is not meant to inſinuate any diſreſpectful idea of the abilities of thoſe who drew the deſigns in the Cabinet-maker's Book of Prices. I doubt not but they were capable of doing more than Heppelwhite has done, without the advantage of ſeeing his book: and it may be, for any thing I know, that the advantage was given on their ſide.

be on as lafting a foundation as can well be expected in a work of this kind. For inftance, the firft part, which provides the workman with geometrical lines, applied to various purpofes in the cabinet branch, cannot be altered any more than reafon itfelf. The fame may be faid of Perfpective; the fubject of the fecond part. This art, being founded on Geometry and Optics, may be improved in its practice, but its fundamental principles can never be altered, any more than the nature of vifion and thofe immutable principles upon which good fenfe is founded.

With refpect to mouldings and various ornaments, the fubject of the third part, it is granted that thefe are of a changeable kind. Yet it is pretty evident that materials for proper ornaments are now brought to fuch perfection as will not, in future, admit of much, if any, degree of improvement, though they may, by the fkill and touch of the ingenious hand, be varied, *ad infinitum*, to fuit any tafte at any time. It may be neceffary to obferve alfo, that this book will have the advantage of exhibiting the prefent and neweft tafte of work; for, whilft we are teaching the practice of Perfpective, the examples given fhall both fhew the neceffary lines for defigning, and likewife reprefent, in different fituations, fome ufeful or fafhionable piece of furniture. To this advantage we fhall alfo add another, namely, that every example in pieces of furniture will have the geo-

metrical

metrical dimenſions laid down on the ground, or other ſcale lines adapted for that purpoſe. So that no perſon, however ignorant of Perſpective, ſhall be liable to miſtake the Perſpective for the geometrical meaſurements, or be at any loſs to know the general ſizes of ſuch pieces as ſhall be introduced*. And we may ſay, with reſpect to changes of faſhions, that he who is properly acquainted with lines, verſed in Perſpective, and ſufficiently practiſed in ornamental drawing, will, from a few hints, be able, at any time, to turn his hand to any faſhion.

Laſtly, I would entreat leave to remark, that, as the publication of this work will be attended with very great expence, the accompliſhment of my deſign will principally depend upon

* The Cabinet-maker's Book of Prices advertiſes thoſe who are ignorant of Perſpective to take care how they apply their compaſſes to the deſigns, leſt they ſhould make any miſtake about the ſizes. But I do not ſee how this can be avoided by ſuch as are ignorant of the art, ſince there are no directions given how to apply them, nor neceſſary ſcales for the purpoſe of obtaining the true meaſurements. They have given a ſcale for the front of their deſigns, which ſerves to give the height and length of ſuch of them as are drawn geometrically in front, but can be of no ſervice in finding the width of a piece of work drawn in perſpective; becauſe its apparent breadth is much narrower than the real or geometrical one. And it may be further obſerved, that we cannot determine the height of a book-caſe merely by a ground ſcale, when the book-caſe is drawn in perſpective, becauſe then the top part recedes or falls back from the front, it is therefore in appearance lower than the real height. For which cauſe, if any perſon was to apply the compaſſes for the height of a piece of work of the above kind, they muſt be totally deceived reſpecting its height. Therefore, in the following work, every difficulty of this kind ſhall be obviated, and proper directions given how to avoid theſe errors, and to apply the compaſſes, ſo as to obtain every neceſſary dimenſion.

the

the encouragement I meet with from you as ſubſcribers; and I hope, on my part, that neither care nor aſſiduity will be wanting to give you all poſſible ſatisfaction, and to render the book as complete as is in the power of,

GENTLEMEN,

Your humble Servant,

THOMAS SHERATON.

INTRODUCTION

TO

PART THE FIRST:

CONTAINING SOME PRELIMINARY OBSERVATIONS.

GEOMETRY literally means, to meaſure the earth *, but in practice is applied to many arts and trades, as well as ſcience in general. With reſpect to that part of it which becomes uſeful to us, it is pleaſant and eaſy, readily underſtood, and of a mechanical nature; ſo that no workman need to be ſhocked or frightened at the idea of learning ſuch geometrical lines and figures as ſhall be conſidered in the ſubſequent pages. Nor is it requiſite to the workman to begin with the uſual definitions in geometry, as theſe would be foreign to my plan, and unneceſſary

* Geometry; from γη ge, the earth, and μετρον *metron*, to meaſure.

for

for him to know. For inſtance, he needs not be told that a point is without parts or magnitude, that a line is length without breadth, or that the terms of a line are points, &c. &c. Theſe, and a number of others of this kind, are known by the common underſtanding of every one. I ſhall therefore confine myſelf to ſuch particulars as every candid workman will at once pronounce uſeful, and which may be applied to the practice of ſome parts of the ingenious art of Cabinet-making. Yet, from what I have here advanced with reſpect to geometrical definitions, I would not be underſtood as ſpeaking diſreſpectfully of them, much leſs to deny their uſefulneſs to ſuch as learn geometry regularly. It is impoſſible to proceed without theſe, when this ancient and divine ſcience is taught as the groundwork of mathematical learning. We might as well attempt to teach logic without a method of arranging or diſtinguiſhing ideas, or arithmetic without the powers and properties of numbers, as geometry diveſted of its chain of definitions and axioms, &c. by which at length we arrive to the certain knowledge of truth, and are able to demonſtrate it to others. But, on the other hand, as it is poſſible for a man of ſound ſenſe to reaſon well without knowing the rules of logic as they are taught in fine and regular ſyſtems, ſo, I apprehend, it is alſo poſſible for a workman of no learning, but what is common, to attain to a uſeful knowledge of geometrical lines, without the trouble of going through a regular courſe of Euclid's definitions and demonſtrations,

monſtrations, &c. And we may juſtly ſay of his definitions and demonſtrations, the ſound of which ſo often alarming the ears of the ignorant, that they are, as a certain writer obſerves, "Built upon a few principles of common ſenſe, without which the moſt domeſtic and ſimple negotiations of life cannot be tranſacted, and that, what they ſhun as ſubjects too ſublime and intricate for their comprehenſion, are only the moſt familiar truths made artificial by regularity and diſguiſed by a technical language."

Upon this view of Geometry, I ſhall now proceed to the conſideration of ſuch Problems as every workman of tolerable capacity will eaſily underſtand, and find advantageous to him.

And, for the ſake of making every part of this book as intelligible and uſeful as I am able, I ſhall, in the courſe of proceeding, explain ſuch * technical terms as may be neceſſarily uſed in the ſubſequent pages, and which, for propriety's and brevity's ſake, cannot well be avoided on ſubjects of this nature. And, in attempting this, I hope not to incur the diſagreeable title of a pedant; as I pretend not to give theſe explanations as the produce of my own ſkill in Etymology, but ſhall recommend them to the reader as they are found in the writings of

* From τεχνη, *techne*, *art*; which belong to the terms and rules of arts and ſciences.

men of unqueſtionable abilities in this way *. Beſides, when it is conſidered that the following work is not written for the learned, but ſuch as may want ſome aſſiſtance in the derivation of particular words uſed in Geometry, Architecture, and Perſpective, in order to fix their real meaning more laſtingly on their memory, it is preſumed that this conſideration alone will, in the view of the candid, ſufficiently apologize for me. As for thoſe of an oppoſite caſt of mind, it is not eaſy to ſay what would pleaſe, or what diſpleaſe, them.

* As Chambers, Johnſon, Bailey, Parkhurſt, Lemon, &c.

THE

CABINET-MAKER AND UPHOLSTERER'S

DRAWING-BOOK.

PART I.

CONTAINING NECESSARY INSTRUCTIONS FOR OBTAINING THE KNOWLEDGE OF SUCH LINES AS ARE USED IN BOTH BRANCHES.

SECT. I.

On dividing a Line into any Number of equal Parts—raising a Perpendicular on a given Point—and the Method of dividing a Frieze or Pilaster into Flutes and Fillets.

* PROBLEM I. PLATE I. FIG. 1.

A RIGHT line being given, to divide it into any number of equal parts. The line to be divided is 7.1, which is to be divided into 7 parts.

Operation.—First, From 7, on the given line, draw a right line at pleasure, making any angle with the line to be divided.

* Problem, προβλημα, *problema*, "from βαλλω, *ballo*, to throw, and προ, *before*, i. e. to propose, or set before: a proposition relating to practice, or which proposes something to be done; as to bisect a line given, to draw a circle through any three points;" or, as in the present case, to divide a line into any number of equal parts.

Then with the foot of your compaſſes, fixed on 7, turn the arch * 1.8, and, without any alteration of the inſtrument, place its foot in 1, and turn the arch 7.9 at pleaſure.

Second, Take the ſpace 1.8, and place it on the arch 7.9 drawn indefinitely †. Then from 1 to 9, draw a right line, which will be parallel, to the line 7.8.

Thus far it ſhould be obſerved, that the problem teaches to draw two lines parallel, both with diſpatch and accuracy.

Laſtly, with your compaſſes, opened at random, lay on the diviſions 1, 2, 3, 4, 5, 6, on both lines, firſt from 1 to 9, then from 7 to 8, and by drawing lines from each correſpondent point, the given line 1.7 will then be divided as required.

A little reflection will point out the reaſon of this, if we conſider that the lines 7.8, 1.9, are perfectly parallel to each other.

For if the diviſions laid on each line be greater or leſs than thoſe ſought for, yet lines drawn acroſs to each reſpective diviſion will cut the line to be divided in the ſame points; becauſe

* Arch, from *arcus*, a bow, *Lat.* and, when uſed in Geometry, implies "any part of a circumference of a circle."

† That is, without bounds or limits.

what

what is loſt or gained on one line, by theſe uncertain diviſions, will be regained or loſt, when the ſame uncertain diviſions are placed the contrary way on the other parallel line. This is clearly exemplified in the figure by the ſmall dotted diviſions on each line, which are ſhorter than the proper ones on the given line. Yet, if right lines be drawn through each correſponding dot, they will cut the given line as before.

The ſmall dotted line drawn acroſs, from the correſpondent points near to 1.5, demonſtrates this, and therefore it is unneceſſary to ſay more.

PROBLEM II. FIG. 2.

To divide a frieze or pilaſter, &c. &c. into any given number of flutes and fillets: the following method is a moſt certain and quick one.

1. Let A B be the ſuppoſed width of the pilaſter required to be fluted.

Operation.—Draw the right line C D indefinitely. Take then two pair of compaſſes, one for the flutes, and the other for the fillets; and with the firſt opening of your compaſſes for the flutes, lay it on C D, and divide this uncertain opening *a b* into three. Again, take one of theſe three parts for each fillet, as *c a*, and

repeat

repeat it on the line C D, firſt a fillet, then a flute, till you have the propoſed number, which in this caſe is 5, (and always in pilaſters ſhould be an odd number*.)

Second, Extend your compaſſes from *c* to *d*, the whole ſpace which the uncertain diviſions include; and with one foot on *c* or *d*, turn the arches E *c* and E *d*, and from the point, where theſe two arches interſect as at E, draw right lines to *c* and *d*, which will then form an equilateral triangle.

Laſtly, Draw lines from all the diviſions on C D to E the angular point. After which, take A B in the compaſſes and turn the arch *e d*, and through the two ſections *e d* draw a right line, then will *e d* be equal A B, and the pilaſter or frieze will be divided in the moſt accurate manner as required.

PROBLEM III. FIG. 3.

To raiſe a perpendicular from any given point on a line as its baſe.

* Obſerve, any opening of one pair of compaſſes will do the whole buſineſs, if a previous calculation be made of the equal parts contained in all the flutes and fillets. Thus, in the preſent caſe, we ſay there are five flutes, allowing the ſpace of three fillets to a flute, which make together fifteen; and the addition of ſix, the number of fillets in the pillaſter, make twenty-one. Therefore lay on the compaſſes at random twenty-one times, and proceed as above.

Operation.—Let G be the given point on the bafe line G V. Take then the * radius G O, or any other at pleafure, and turn the arch O S. Fix again your compafs foot in O, and, without any alteration, interfect the arch at P. On P, with the fame opening of the compaffes, make another fection at S, and from thofe points S P turn an arch each way, and their interfection will form a point perpendicular with the given point G, as required.

This may alfo be effected another way with more difpatch, but perhaps not always with equal accuracy.

Operation.—Let M E, Fig. 14, Plate 2, be the bafe, and E the point whence you would erect a perpendicular. With any opening of the compaffes, and with one of its legs fixed any where out of the line, as at S, fweep the arch *b*, *d* till it cut the bafe line, as at *b*. Then from *b* draw *b s* through the center S, cutting the arch at *d*, and their fection will form a point perpendicular to E, as required.

These problems may be very ufeful to an Upholfterer when he is laying down the plan of a room for a carpet, as it is not convenient always to take a fquare with him. Befides, by a good line, bradaul, and chalk, a perpendicular may be raifed

* Radius, a right line drawn from the center of a circle to its circumference. This right line, I conceive, anfwers to the rays of light (in an optical fenfe), which, falling upon the eye every where in right-lined directions, form a horizon to our fight.

 with

with more exactneſs than can be drawn on a floor by a ſquare. But, as I intend giving ſome directions to the Upholſterer how to lay down a room in an accurate manner, ſo that a carpet may be properly cut by his plan, I ſhall at preſent ſay nothing more on this ſubject.

PROBLEM IV. FIG. 4.

To draw a perpendicular line by a ſcale of equal parts, as by a common rule, or by a rod divided.

Operation.—Let the line G V be the line required to raiſe a perpendicular from. Let V be the propoſed point, and from any ſcale of equal parts lay down ten of thoſe parts from the point V towards G. Take then ſix of thoſe parts (or ſix inches of the common rule) and turn the arch 1.2 at pleaſure. Again, take ten parts, or ten inches of your rule, and place the end of the rule or rod on the eighth of thoſe ten parts or inches, and with the other hand, by a pencil, interſect the arch 1.2, by which a point will be gained exactly perpendicular to V, as required.

This problem will be of uſe to the Cabinet-maker and Upholſterer when neither ſquare or compaſſes are at hand. For inſtance, if a Cabinet-maker would cut a board acroſs perfectly ſquare, without compaſſes, chalk line, or ſquare, if he have but a rod, let him proceed thus:

Divide the rod into ten equal parts, and by this ſtraight rod ſtrike a line on the ſide of the board; then lay down ten parts on this line, and proceed as above.

SECTION II.

On the Uſe of a common Caſe of Inſtruments, together with ſome Geometrical Problems conſidered.

As the various inſtruments found in common caſes are not commonly underſtood by Cabinet-makers and Upholſterers, and as the principles by which they are deviſed and conſtructed are purely geometrical, I think it neceſſary and uſeful to give an explanation of them, ſo far as they can any way aſſiſt the above perſons, or others, in the practice of drawing.

The firſt thing that needs be noticed is a ſcale of feet and inches.

The intention and uſe of a ſcale is to reduce the real meaſurements of any object to a convenient proportion, ſo that it

may be reprefented on a fheet of paper, &c. with as much exactnefs as if it were drawn at full fize*.

A fcale of feet and inches fhould be ufed when we reprefent any piece of furniture either geometrically or perfpectively, becaufe fuch a fcale anfwers to our common rules; but when we lay down any figure by the help of mathematical inftruments, then a fcale of tenths muft be ufed.

On the Conftruction and Ufe of a Scale of Feet and Inches.

To underftand a fcale of feet and inches, draw feven lines parallel to each other, and at equal diftances, as in Plate I. Fig. 9. Then, as on the line 1, 2, 3, lay down as many divifions for feet as will comprehend the largeft dimenfion of the piece you would draw. Secondly, divide one of thefe parts, which you fuppofe to be a foot, into twelve equal parts, the number of inches in a foot; to effect which, divide that part or foot into two equal parts, as at 6: draw then the two lines 6.1, 6.12, and the foot will be divided as required, and in the moft ac-

* The term Scale feems to have been derived from the fteel-yard, and its notches or divifions marked on the beam, to adjuft the different degrees of weight by.

curate manner, as is clearly demonſtrated by the ſmall diviſions on the line 12.

To uſe the Scale.

IF you want one foot one inch, place your compaſs foot on the ſecond line from the bottom, over 1, and extend the other foot to No. 1 on the ſame line. Again; if you want one foot two inches, then place the foot of your compaſſes on the third line from the bottom, over 1, and extend the other foot to No. 2 on this line. Laſtly; if you want three feet ſeven inches, place one foot of your compaſſes on the ſixth line, over 3, and extend the other foot to No. 7, and ſo on for any other number of feet and inches that may be required.

On the Conſtruction and Uſe of a Scale of Tenths.

Draw eleven lines parallel to each other, and at equal diſtances, as in Fig. 10, Plate II. Afterwards lay down eleven diviſions, as you ſee on the ſcales found in caſes of inſtruments (I have divided mine only into ſix, for want of room). Take one of thoſe diviſions or parts, and by Prob. I. Fig. 1, divide it again into ten equal parts, placing the diviſions on the bottom and top line. Then from the point *o* draw a line to the point before 2 on the top line, and ſo on, as the Figure ſhews. When all theſe lines are drawn, there will then be preciſely one hundred equal

parts,

parts, diſtinguiſhable by the dots on the ſeveral angles of the rhombs, becauſe, being divided into ten each way, they multiply into one hundred, by which we ſhall be able to take any tenth or any hundredth part of the large diviſions 1, 2, 3, 4, &c.

To uſe this Scale.

If you want one of the large diviſions and one 10th, this is aſcértained by placing one foot of your compaſſes on No. 1, and extending the other to the firſt diviſion beyond *o*, and ſo on, as may be required. Again, if you want one large diviſion (which may be called a foot) and nine hundredth parts of a foot, place one foot of your compaſſes on the line 9, and extend the other to the firſt tenth on that line, and you will then have one foot and nine hundredth parts as required. Laſtly, if you want five feet five tenths of a foot and five tenths of an inch, place your compaſs foot on No. 6, on the right hand end of the ſcale, which is the ſixth line from the bottom, and extend the other foot to the ſixth dot on the ſame line, and the required dimenſion will be obtained. It will be evident therefore, by a little reflection on the nature of this ſcale, that any tenth part of a foot, and any tenth part of an inch, may be accurately taken.

The ſcale of chords comes next under conſideration. This ſcale is commonly found on the contrary ſide to that whereon

whereon the ſcale of tenths is marked, which we have now deſcribed. The uſe of it is to lay down angles of different degrees, and to divide a circle into various proportions and parts.

The Conſtruction and Uſe of a Scale of Chords.

1. Open the compaſſes to ſixty degrees on the ſcale marked CHO, Fig. 11, Plate II. and by this opening deſcribe a ſemicircle, as BDA, Fig. 12. Then if the arch BD be divided into ten equal parts, thoſe parts 10, 20, 30, &c. will anſwer to 10, 20, 30, &c. on the ſcale of chords, Fig. 11. Hence, if you want to divide a circle into twelve parts, take thirty from the ſcale of chords, and apply the compaſſes to the arch BD at 30, then BD will contain it three times, and conſequently the whole circle will contain it twelve times. If again you want this circle divided into eight equal parts, then from the ſcale take the chord of 45, and apply it to the arch BD at 45, and this will divide the quadrant into two equal parts, and therefore the whole circumference may, by the ſame opening, be divided into eighths. In this manner any other diviſion of a circle may be certainly known at once, which a little thought will eaſily make clear, and therefore it is unneceſſary to give any other example on dividing a circle into equal parts.

This

This ſcale may likewiſe be uſed in laying down any angle* not more than ninety degrees. Draw the line G *o*, Fig. 16, at pleaſure; then take the chord 60° and ſweep the arch *o o* at pleaſure. With your compaſſes take the chord 37°½ and place it on the arch *o o*; draw the right line G *o*, and you have an angle of thirty-ſeven degrees and an half, and ſo of any other, to ninety degrees.

On the PROTRACTOR †.

THE Protractor is a ſemicircle of braſs, divided into one hundred and eighty degrees, by the help of which we may deſcribe an angle of any aſſigned quantity whatever, and likewiſe meaſure any angle already laid down.

Let the arch, divided into one hundred and eighty equal parts, on the line A B, Fig. 6, Plate I. be conſidered as the braſs protractor, which is found in common caſes of inſtruments.

* Angle. "This ſeems to be from Αγκυλος, *ankulos*, the bending of the elbow;" and in Geometry, implies the point in which two lines meet: but the quantity of an angle is the ſpace comprehended between the two lines meeting in a point, as *o o*, Plate II. Fig. 16, and its proportion is expreſſed by degrees; which term, Degree, means ſimply the three hundred and ſixtieth part of a circle, whether great or ſmall.

† Protractor, from *protractum*, "to draw out in length;" accordingly, by the help of this inſtrument we may draw out the legs of a triangle to any length we pleaſe.

First, obſerve the center of the protractor, diſtinguiſhed by a ſmall notch on the diameter, anſwerable to 6, on A B, Fig. 6.

2d. Let it be required to lay down an angle of ninety degrees, and let A B be conſidered as the baſe. Then place the ſmall notch on the diameter of the braſs protractor, upon 6, on the line A B, and make a mark exactly over 90; conſequently a line from 6, the center, to 90, the vertical* point, will form an angle of ninety degrees, or what we commonly call a ſquare:

Again, if an angle of forty-five be wanted, proceed as before, and make a dot over 45; to which draw a line from the center, and it will be an angle as required; and ſo of any other to any quantity. This is ſo plain, that to ſay more would be needleſs. It may however be proper to obſerve, that the quantity of any angle already laid down may alſo be found by the protractor as follows.

Let G *o o*, Fig. 16, Plate II. be the angle to be meaſured. Take the Radius, or half diameter of the protractor, and ſweep the arch *o o*; then open the compaſſes to *o o*, and apply them to the degrees marked on the inſtrument, and it will immediately be ſeen how many of thoſe diviſions are contained in the angle, which number of diviſions are called the quantity of the angle.

* *Vertical*, "placed in a direction perpendicular to the horizon."

On the SECTOR*.

The Sector is a most universal instrument, and used for various purposes in the different branches of mathematical learning. Nor is it without its usefulness in the art of drawing, and therefore those who are concerned with designing ought, in some measure, to be acquainted with it.

To this end let us first consider the most simple part of it, which is, to divide any given right line into any number of equal parts.

The line to be divided by the sector is 7.7, Plate I. Fig. 5, which is to be divided into seven.

First, Look for the line of lines on the sector, which may be found by observing two brass centers marked with L on each limb of the instrument.

Second, Take the length of the line 7.7 in your compasses, and place one foot on the point 7 on the line of lines, and opening the sector, extend it till the other leg of the compasses co-

* Sector; it is so called because, when it is opened, it comprehends a portion of a circle between two semidiameters, making an angle at the center, as O A 4, Plate I. Fig. 6.

incides

incides with the point 7 on the other limb of the inſtrument, as Fig. 5 clearly expreſſes. In this poſition keep the ſector, and moving the compaſſes to 1.1, which is the neareſt figure to the center of the inſtrument, contract their legs till you take the opening 1.1, which, if correctly done, will be one-ſeventh part of the line 7.7, as propoſed. Perhaps it may be required to divide a line into fourteen; if ſo, then as there are only ten on the line of lines, you take half the length of the given line in your compaſſes, and place their legs on the points 7.7 as before; and, as this opening is but half the length of the line to be divided, the compaſſes muſt be contracted to 1.1 as before, and then the line will be divided into fourteen, becauſe twice ſeven is fourteen.

In this way any right line, to be divided into any number of parts, may be brought upon the ſector. To make this ſtill more plain, let it be propoſed that a line twice the length of the line 7.7 is to be divided into twenty-eight equal parts. Take the line 7.7 in your compaſſes, and proceed in all reſpects as before, except one thing, i. e. in place of contracting the legs of the compaſſes till they touch the points 1.1, you muſt draw them in till they touch the lines at half the diſtance of 1.1 from the center, as the dark line next the center of Fig. 5 ſhews. This opening of the compaſſes will turn fourteen times on the

line 7.7, consequently it will turn twenty-eight times on a line twice its length.

Of the Line of Polygons on the Sector.*

This line is intended to divide a circle into equal parts, by which any kind of Polygons, from a pentagon to a duodecagon, may be formed. Hence it is distinguished by the letters POL on this instrument.

Let it be required to divide the circle, Fig. 8, into five, which forms a Pentagon. Take the radius or half diameter of Fig. 8, and opening the sector, as described by Fig. 7, place the compass on the point 6.6, marked radius. In this position keep the sector, and, without any variation of the instrument, you may divide the circle 8 from 4 to 12. In the case before us it is into five; therefore take the compasses from the points 6, and extend them till they touch 5.5, and this opening will go five times on the circle 8, as will be evident if you take 5.5 in your compasses from Fig. 7, and apply it to Fig. 8.

Lastly, if you want the circle 8 divided into twelve, by which to form a Duodecagon (see Plate II. Fig. 26), the sector still remaining unaltered, place your compass legs on the points

* "Polygon, from πολυς, *polus*, many, and γωνια, *gonia*, a corner, having many corners or angles."

12.12,

12.12, and apply them to the circle 8, and it will be divided as required.

Obſerve alſo, that a geometrical ſquare may, by the ſame means, be inſcribed in any circle; for by keeping the ſector extended as before, and opening the compaſſes till their legs touch on 4.4, this opening will turn four times on the circle 8, and therefore will form a ſquare.

How this line of Polygons is divided ſo as to proportion any circle in this manner, will eaſily be underſtood by conſidering Fig. 6.

Deſcribe a circle of any radius, and draw the diameter A, B. Divide one-half of the circumference into one hundred and eighty equal parts, called degrees, and from 90° draw the arch 4 from the center A, then will the lines A O and A 4 repreſent the limbs of the ſector, Fig. 7, and 4 on Fig. 6 will anſwer to 4 on Fig. 7.

Next draw the arch 5 from 72°, and from the center to 5 will be the chord of 72°, the degrees contained in the ſide of a Pentagon, anſwerable to 5.5 on Fig. 7.

Proceed to the arch 6, and obſerve, that this is the radius

 of

of the circle, and is always equal to the chord line 60°, and therefore contains a length equivalent to the ſide of a Hexagon, or a ſix-ſided figure, and agrees with 6.6 on Fig. 7.

After theſe remarks, I think it unneceſſary to go through each chord line; only the reader ſhould obſerve, that I have marked ſuch chords as have fractional parts on the fine lines, or thoſe drawn perpendicularly from A, B. For inſtance, the chord for a Heptagon is fifty-one degrees and three-ſeventh parts of a degree; and the meaning of three-ſeventh parts is nothing more than to divide a degree into ſeven, and to take three of thoſe parts and add to fifty-one, which is exactly the ſide of a circle divided into ſeven, called a Heptagon. Theſe parts are eaſily found and proved by dividing three hundred and ſixty, the number of degrees contained in a whole circle, by the quantity of ſides contained in any Polygon, for then the quotient will be the number of degrees which are in the arch of every ſuch chord line.

Thus for a Heptagon; divide three hundred and ſixty by ſeven, then will the quotient be fifty-one degrees and three-ſevenths, equal to the ſide of a heptagon.

Of the Line of Chords on the Sector.

The Chords on the fixed ſcale have already been conſidered (ſee page 29). Theſe chords are limited to one circle, which, to ſuit that ſcale, muſt always be drawn by the compaſſes extended to ſixty degrees: but the ſcale of chords on the ſector is unlimited, becauſe the chords of circles of various radiuſes may be found according as the limbs of the inſtrument are more or leſs extended.

The line of Chords is on the ſame ſide of the ſector with the Polygons, marked with *c* nigh to a braſs center on each limb: and if it be required to find the chord of thirty of any circle, take the radius of the given circle, and open the ſector till the compaſs legs coincide with thoſe braſs centers at 60.60, then contracting the compaſſes till their legs touch 30.30, the required chord line will be found. In this manner proceed in any other caſe; always obſerving that the ſemi-diameter of the circle muſt limit the opening of the ſector at the braſs centers.

By this line of Chords on the Sector it is evident that a circle may be divided into ſeven hundred and twenty equal parts with conſiderable diſpatch and great accuracy.

Of the Line of Sines on the Sector.

A Sine is a right line drawn from one end of an arch perpendicularly upon the diameter drawn from the other end of that arch, as the perpendicular line 90, drawn from the diameter BA, Fig. 12, Plate II. is the ſine of the arch BD; and ſo likewiſe all the other perpendicular lines, as 1, 2, 3, 4, 5, &c. on the line BA, are ſines of ſo many different portions of the arch BDA.

The line of Sines on the ſector, which Fig. 13 is intended to repreſent, is marked *s s* nigh 90.90, with two braſs centers, one on each limb of the inſtrument. The ſeveral diviſions on this line, marked 10, 20, 30, &c. anſwer to theſe perpendicular lines 1, 2, 3, 4, 5, &c. on the line BA, Fig. 12, and the different ſituations of thoſe perpendicular lines are found by dividing the arch DA into nine equal diviſions. Perpendiculars being then drawn from each reſpective diviſion on the circumference of the circle to the diameter AB, they are of courſe denominated ſines of 10, 20, 30 degrees, and ſo on.

To draw an Oval by the Sector.

Firſt, Draw a circle that will comprehend the longeſt diameter of the oval you wiſh to deſcribe, as the circle BDA, Fig. 12. Divide the quadrant DA into nine equal parts.

Second,

Second, Take then the ſhorteſt diameter in the compaſſes, and place one foot on the ſine 90°, and open the ſector till the other coincides or touches 90° on the other limb of the inſtrument. In this poſition keep the inſtrument fixed, and contract the compaſſes till their feet touch the ſine 80°.80°; transfer this opening of the compaſſes to the perpendicular line 8 at 80, which mark with the point of a pencil.

Proceed to the ſine 70, keeping the ſector ſtill in the ſame poſition, and, after contracting the compaſſes till their legs touch 70.70 on the ſector, transfer this opening to the perpendicular line 7 at 70°, and ſo on of all the reſt to the ſine 10, by which will be obtained nine points, contracted in due proportion* from the arch D, A; and a line, paſſing through each of theſe points, and drawn by a ſteady hand, will form an ellipſis perfectly true and agreeable, as is evident by the figure.

From what has been ſaid, I preſume it will eaſily be underſtood by every one how to proceed with the other quarters to complete the whole ellipſis.

* This is evident by obſerving, that as a right line drawn from 45 on the tangent line to the center 9, cuts the arch D A in the degree 45; ſo likewiſe will a right line drawn from 10 on the tangent line to the center, cut the elliptic arch 90 A in the ſame degree.

A circle

A circle may alſo be deſcribed by the ſector upon the ſame principle that an ellipſis is drawn by it. This, in itſelf, is not very neceſſary to be known, becauſe when we have no compaſſes, no uſe can be made of the ſector, and when we have them by us, they are the beſt inſtrument for drawing a circle. However, ſince what belongs to the drawing of a circle by the ſector, partly belongs to the deſcribing of an ellipſis by this inſtrument, I ſhall venture upon this Problem.

Operation.—Draw a right line at pleaſure, of length enough to contain the diameter of the circle to be drawn. Biſect * this line, and draw a line at right angles with it of the ſame length. Take then the ſemi-diameter of the circle, and place it on the lines each way.

Open the ſector, and on the line of ſines proceed as before to take the ſine 80. Transfer this to any ſemi-diameter, as 9 A, Fig. 12, which will extend to 1 on that line. Then proceed to take the ſine 70, and transfer this alſo, which will extend to 2 on that line. Proceed to the ſine 60, and this opening will ex-

* A line is ſaid to be biſected when it is divided into two equal parts, from "*bis* and *ſectum*, to cut in two;" an operation which is eaſily performed by ſweeping two arches from the extremities of the line to be thus divided; as from *b* and *d*, in Fig. 14, where two arches interſect, which if a line be drawn from theſe interſections, it will both biſect the given line, and will at the ſame time be drawing one at right angles to it.

tend to 3 on the ſame line, and ſo on, till you take the ſine 10, which will extend from 9 to 8. The ſame muſt be done on the other radius, as you take the ſines from the ſector. Having thus divided one diameter, draw perpendicular lines from each diviſion each way at random. Laſtly, take the ſame ſines again from the line 9 A, and place them upon their reſpective ſines; that is, take from 9 to 1, which is the ſine 80, and place this upon the perpendicular line 8 at 80, and ſo of all the reſt, and they will form thirty-ſix points for the whole circle; through which points, if a line be correctly drawn, the circumference of a complete circle will be produced with as much accuracy as when we draw the circumference of an oval in the ſame manner.

Of the Tangent Line on the Sector.*

A tangent is a right line drawn perpendicular on the extremity of ſome radius, touching the circumference of the circle, but not cutting it, as A 45, Fig. 12.

This line is of uſe to divide the circumference of a circle into any number of equal parts, and may be found on the ſector by a braſs center on each line, marked T. To this line there

* Tangent, from *tangens*, Latin, touching.

is added another of the ſame kind, marked T on each limb, but without a braſs center to it.

To divide a circle by this line, proceed thus:

Take the radius of the circle to be divided, and with this opening, place the compaſs legs on each line T, marked 45.45, then will the ſector be prepared for finding every degree of a circle up to 45. This is clear; for if the radius be laid down on the tangent line, Fig. 12, as at 45, a line drawn from 45 to 9, the center, will cut the arch D A at 45 degrees, as is obvious by inſpection. Thus the circle may be divided into eight, ſince forty-five is the half of ninety, conſequently the eighth of three hundred and ſixty. The ſector being ſtill in the ſame poſition, if you want to cut the arch D A at 10 degrees, contract the legs of the compaſſes till they coincide with 10.10 on the tangent line, and transfer this on the tangent line A 45, and a right line being drawn to the center as before, it will cut the arch D A at 10. Hence if the arch D A is required to be divided into nine, the extent of the compaſſes at thoſe ten degrees will turn nine times on the arch D A.

It has already been obſerved, that there are two tangent lines on the ſector. The tangent line which has not the braſs center, is to increaſe that which has one up to 75, as it is marked

on

on that line. When therefore any degree above forty-five is wanted, take the radius of the circle to be divided, and open the ſector till the compaſs legs touch 45 on the ſecond tangent line on each limb; then will the inſtrument be prepared for taking the tangent of any degree up to ſeventy-five, by proceeding in the ſame manner as on the firſt tangent line.

SECTION III.

On the Names and Properties of various uſeful Geometrical Figures of the Superficies.

To have ſome knowledge of the names of uſeful geometrical figures is certainly of advantage to every one, and eſpecially to ſuch perſons as are concerned with drawing or making pieces of work of the like forms.

It is certain from experience and matter of fact, that many, not acquainted with names of this kind, are obliged to uſe a dozen words and ſigns when one would be ſufficient.

Befides, a knowledge of thefe names, together with an acquaintance with the general properties and manner of drawing fuch figures, muft certainly be confidered as an introductory ftep to a more advanced knowledge of Geometry, by thofe young men who intend to rife higher in this fublime fcience, than can be expected to be taught in a drawing-book.

I fhall therefore begin with the names and properties, and afterwards defcribe the conftruction, or manner of drawing, the moft generally ufeful figures.

Of the Superficies *. (See Plate II.)

No. 1, is a Geometrical Square, fo called becaufe it has four fides of equal length, and four right angles.

No. 2, is a Parallelogram. This figure receives its name from its oppofite fides and ends being all parallel to each other.

No. 3, a Rhomb, which is properly a geometrical fquare moved out of its pofition, fince all its fides are equal, but not its angles, two of them being acute, and the other obtufe.

* Superficies, *fuperficies*, Lat. the furface or outermoft part of any thing, and in Geometry are fuch figures as are bounded by one or more lines, or an extenfion which has length and breadth, but no thicknefs.

No. 4, is a Rhomboides, a figure which bears the ſame affinity to a parallelogram that a rhomb does to a geometrical ſquare. A rhomboides has its ſides and ends parallel to each other, but its angles differ the ſame as thoſe of the rhomb; and therefore a rhomboides is a parallelogram moved out of its proper form.

No. 5, is a Trapezoid, which has four ſides, two of which are parallel, and two not, the ſame as the ſeats of ſome chairs.

No. 6, a Trapezium, containing four ſides, which are all unequal, and none of them parallel.

Theſe ſix figures, being all of them bounded by four right lines, are, by geometricians, called quadrangular or quadrilateral plain figures.

Of various Triangles.

No. 7, is an Equilateral Triangle, ſo called becauſe all its ſides are equal to one another; and, as every triangle contained under three equal ſides, whether circular or mixed, are called equilateral, ſo the figures 11, 12, 15, are alſo of that denomination.

No. 8, is a Right-angled Triangle, becaufe two of its fides are perpendicular to each other, and confequently make an angle of ninety degrees, as the line 9.90°, Fig. 12, is perpendicular to B A, therefore A 9.90° forms a right-angled triangle, comprehending a part of a circle equal to ninety degrees.

In all right-angled triangles, the fides containing the right angle are called the Legs, as the fides 9 A, A 45 are the legs of the triangle 9 A, 45, in Fig. 12; and the oppofite fide to the right angle is called the Hypothenufe, as the line 9.45, in the triangle 9 A, 45, is the hypothenufe fide of that triangle.

"The perpendicular height of any triangle is a line drawn from the vertex to the bafe perpendicularly:" thus if the triangle PEO, Fig. 15, be propofed, PO muft be confidered as its bafe, and confequently E its vertex; and if from E you draw the line EP perpendicularly to PO, then the line EP is the height of the triangle EPO, ftanding on PO, its bafe.

No. 9, is a triangle called Scalenous, becaufe none of its fides are equal, nor its angles alike in quantity. A Scalene Triangle is compofed of two kinds of angles, one obtufe, and the other acute; fo alfo a right-angled triangle is compofed of two, a right one, and an acute.

All other triangles are of the acute kind.

An obtufe * angle is one that is greater than ninety degrees, or more than what we call a fquare, as a line from 9 to the point D, Fig. 12.

An acute angle is lefs than ninety degrees, as a line from 9 to 10, confidering the fide 9 A as their bafe.

No. 10. This triangle is called Ifofceles, becaufe two of its fides are equal in length, as G *o*, G *o*, Fig. 16; or if the fector be opened, a triangle of this kind is fitly reprefented by it.

Thefe four triangles, being bounded by three right lines, are called rectilineal plain triangles; and in general, thefe are placed before the quadrilateral, or four-fided figures, becaufe by geometricians they are confidered as more fimple, having only three fides: but as triangles generally appear more out of the way to workmen, I have affumed this liberty to place them after four-fided figures.

Of mixed Triangles.

Of this kind are numbers 11, 12, 13, 14, and they are called mixed triangles, becaufe fome of their fides are right lines, and

*. Obtufe fignifies flat or blunt, and acute fharp or cutting.

fome

ſome curved ones. Three of theſe are equilateral, or equal-ſided, if meaſured by a right line; and No. 14 is a ſcalene triangle by the ſame rule, as none of its ſides are equal. The ſides of theſe mixed triangles that are round, are called convex*, but thoſe that are hollow, as No. 13, 14, are called concave.

Of Spherical† Triangles.

A ſpherical triangle is one that is curved on every ſide, as No. 15 and 16. Theſe are both of the equilateral kind, becauſe their ſides may be bounded by right lines of equal length.

Of Mixtilineal Figures.

No. 17, is of this kind; and every other figure that is bounded both by right and curved lines is called mixtilineal.

Of theſe figures ſome are regular, and ſome irregular.

When a figure of this kind is compoſed of equal curved and equal right lines, then it is called a regular compound mix-

* Convex is properly applicable only to any ſolid that has a curved or ſwelled ſurface, and concave is the contrary.

† Spherical, ſomething like a ſphere or globe.

tilineal

lineal figure; but when its ſides and ends are formed of unequal curved and unequal right lines, then they are called irregular compound mixtilineal figures.

Of this ſort is No. 18.

Of Polygonal Figures.

All Figures bounded by more than four right lines are termed Polygons.

The figures included between No. 19 and 26 are all of this denomination. But each of theſe figures has its particular name from the number of the ſides of which it is compoſed.

No. 19, is therefore called a regular Pentagon*, becauſe it is bound by five right lines of equal length; but if any of thoſe lines were unequal in length, then it would be termed an irregular Pentagon. The ſame diſtinction is applicable to any other of theſe figures in ſuch caſes.

* Pentagon, from πέντε, *pente*, five, and γωνια, *gonia*, a five-cornered figure. The other Polygons have all their particular names formed in the ſame way, from the Greek numeral adjectives.

No. 20 is termed a Hexagon,	because it has	6 ſides or angles.
21 a Heptagon,		7
22 an Octagon,		8
23 a Nonagon,		9
24 a Decagon,		10
25 an Undecagon,		11
26 a Duodecagon,		12

No. 27, is a figure ſo well known that it is unneceſſary to ſay any thing about it.

The ſame may be ſaid of the Semi and Quadrant, Nos. 28 and 29, the one being an half, and the other one-fourth of a complete circle.

No. 30, is called the Greater Segment * of a circle, becauſe it is the greateſt part of a circle cut in two by a right line; and of courſe No. 31 is the Leſſer † Segment, becauſe it is not equal to a ſemi. But if we ſpeak of a ſegment without regard to compariſon, it is a figure contained between a chord and an arch of a circle.

* Segment, from *ſegmentum*, a piece cut off.

† Leſſer. This way of forming the comparative adjective is by Dr. Johnſon and Lowth conſidered as barbarous; but as cuſtom has ſo long prevailed in the uſe of it, and as the ear ſeems to prefer leſſer rather than leſs, I thought it would ſuit the readers beſt to retain it.

No. 32, is an Ellipſis *, commonly called an oval. This figure may be conſidered, in one view, as produced by the ſection of a cone, by a plane cutting both ſides of the cone obliquely to its baſe. In this caſe the ellipſis produced muſt be irregular, ſince a cone is a ſolid which terminates to a point at the top; and therefore any ſection oblique to its baſe muſt produce an oval broader at one end than the other. To demonſtrate this, nothing more is requiſite than to get a piece of wood turned in the ſhape of a ſugar-loaf, and let it be ſawn acroſs in a ſloping direction from the bottom of it, and the ſurface of the cut will be an irregular oval. But if a cylinder be cut oblique to its baſe, there will then be produced an Ellipſis perfectly regular, and alike at each end.

It may alſo be obſerved both of a circle and an oval, that they are the only regular ſuperficies that are bounded by one line; and thoſe which are bounded by two, are their reſpective ſegments: as Figures 28, 30, 31, 33, 34.

No. 33, is the Semi-ellipſis, or Half-oval; and it is ſaid to be on the tranſverſe diameter, when the right ſide is equal to the

* Ellipſis, from ἔλλειψις, *ellipſis*, a defect or omiſſion. If a ſuperfice be apparently round, but, on meaſuring it, if one of its diameters be found ſhorter than the other, there is then a defect, and we ſay that the figure is elliptic.

 longeſt

longeſt diameter; but when it is only equal to the ſhorteſt diameter, then it is ſaid to be on the conjugate, as No. 34.

No. 35, is termed an Hyperbolic Figure. When a cone, Fig. 12, Plate IV. has a ſection parallel to its axis, the curved boundary produced by the ſection is an Hyperbolic Figure; and when its ſection is parallel to the ſides of the cone, then the curved boundary produced is called a Parabolic Figure.

SECT. IV.

Of the Manner of drawing various uſeful Geometrical Problems.

In the preceding ſection, the names and ſome of the properties of the moſt generally uſeful ſuperficies have been conſidered; and I ſhall now deſcribe the method of drawing them. However, in doing this it will not be neceſſary to deſcribe every particular figure, ſince the ſame operation for one will ſometimes apply to various others.

PROB.

Prob. V. Fig. 14.

To draw a Geometrical Square.

By the fecond method of Prob. III. raife a perpendicular, as E *d*, Fig. 14, Plate II. then extend the compaffes equal to the fide of the propofed fquare.

Fix one foot in E, and fweep the arch *b d*, which will cut the line E *b*, E *d*, equal to the fides of its fquare. Laftly, from *d* and *b*, with the fame opening of the compaffes, fweep the other arches, and their fection will form a perpendicular to the points *b* and *d*, by which the fquare is completed.

From what has been faid, it will eafily be underftood how to draw a Parallelogram.

Prob. VI. Fig. 2 and 16.

To draw a Rhomb.

If the fides of this figure be intended to incline at an angle of fixty degrees, all that is neceffary is to draw two equilateral triangles from their oppofite bafes: and to draw an equilateral triangle is nothing more than to take in the compaffes the given

fide

ſide of the triangle, and from a right line turn an arch each way, as Fig. 2, Plate I. and their ſection, as at E, by lines drawn to it, completes the figure.

Then if a right line be drawn parallel to C D at E, and *c d* be laid on this line, ſuppoſed to be drawn, it will complete the Rhomb.

But if a Rhomb be required to be drawn, whoſe oblique ſides are wanted to be inclined thirty-ſeven degrees and a half, take the radius of the protractor and from the center G ſweep an arch, as *o o*, Fig. 16. Draw G *o*, and take from the protractor thirty-ſeven degrees and a half, and lay it from *o* to *o*. Let the right line G *o* be the given ſide of the Rhomb; and how the other ſides are to be drawn, reaſon itſelf will dictate.

The Rhomboides, being of the ſame ſpecies of figure, is eaſily drawn by the ſame rule. Nor is it requiſite to deſcribe the method of drawing any other of the figures till we come to the Pentagon, becauſe ſome of them are variable, and thoſe that are not ſo, are drawn by the ſame rules that are applicable to the Square, Rhomb, and Equilateral Triangle.

PROB.

PROB. VII. FIG. 19.

How to draw the Polygons.

To draw a Pentagon whoſe ſides ſhall be equal to a given length, as the line 12.1, Fig. 19, Plate III.

Operation.—Draw a right line 12.1, and take the ſide 12.1 of the propoſed Pentagon. Place one foot of the compaſſes on 12, and with the other ſweep the arch 1.1. Again, place the compaſs foot on 1, and ſweep the arch 12.1, and through the point where theſe arches meet raiſe a perpendicular line, and continue it at pleaſure. Divide the arch 12.1 into ſix equal parts. Take then the firſt of theſe parts, and ſweep it to the perpendicular line downwards, as the figure clearly ſhews; and from this point on the perpendicular line extend the compaſſes to 12, which will be the radius of a circle that will contain 12.1 five times: therefore, with the compaſſes thus fixed, deſcribe the circle, Fig. 20, and it will admit of 12.1 five times, forming a regular Pentagon.

And here it ſhould be obſerved, that what has been done in this Problem for drawing a Pentagon, prepares the way for drawing any Polygon up to 12, whoſe ſides are equal to 12.1: therefore, in deſcribing the other Polygons, I ſhall proceed as being thus far advanced.

PROB.

PROB. VIII. FIG. 19.

To defcribe a Hexagon, whofe fides fhall be equal to any given length.

Operation.—Take 12.1, the fuppofed dimenfion of the fide of the Hexagon, and with this radius draw a circle, whofe center is at the interfection of the two arches 12.1, 1.1, then will the radius turn fix times on the circumference of that circle, as the fmall dafhes which are on it fpecify. It may be made a general rule without exception, that whatever the diameter of a circle be, its radius will always divide the circumference into fix.

PROB. IX. FIG. 19.

To defcribe a Heptagon, whofe fides fhall be equal to any given length.

Operation.—Take one of the parts on the arch 12.1, and fweep it to 7 on the perpendicular line. Extend the compaffes from this point 7 to 12, which will be the radius of a circle that will contain the given fide 12.1 feven times, which forms a Heptagon.

If an Octagon be wanted whofe fides are equal to 12.1, take from

from the center two parts, and ſweep the arch 2.8. Laſtly, extend the compaſſes from 8 to 12, which, as before, will be the ſemi-diameter of a circle that will contain the given ſide 12.1 eight times, by which an Octagon may be formed.

In the ſame manner proceed with the other to a circle that will contain the given ſide twelve times, as the largeſt circle in the figure evidently does, as marked by the figures 1, 2, 3, &c.

In the preceding directions for drawing the Polygons, their ſides are previouſly determined as to their length, but the circle that will contain the ſides ſo many times, is required to be found. We ſhall now change the order, and propoſe a given circle, in which ſhall be inſcribed any Polygon of the above kinds.

PROB. X. FIG. 21.

Therefore a circle being given, let it be required to find the ſide of a Pentagon that may be inſcribed within the given circle.

Operation.—Let the line 9.5 be the diameter of the given circle.

Biſect the diameter, and draw a line at right angles with it; then with the radius *s* 9 deſcribe the circle.

Second, Divide any of the quadrants of this circle into five equal parts, and a chord line extended to four of thefe parts will be the fide of a Pentagon that may be infcribed in the given circle, as the figure plainly fhews.

PROB. XI. FIG. 21.

To find the fide of a Heptagon that will infcribe within a given circle.

Operation.—Let Fig. 21 be the given circle as before. Divide any of the quadrants into feven, as the under right hand one in the figure.

Take then four of thefe divifions in your compaffes, and the whole circle 21 will contain it feven times, which forms a Heptagon.

In this way proceed with the other Polygons, always obferving, that whatever number of fides the Polygon is required to have, the quadrant of the given circle muft be divided into the fame number of equal parts, and four of thefe equal parts muft always be taken for the fide of the Polygon without exception. This is exemplified on each quadrant of the circle, which has already been referred to, and, by a little infpection and reflection, cannot fail to be underftood.

The

The ſimplicity of this method of inſcribing Polygons in any circle, makes it highly uſeful to all who are any way concerned with deſcribing ſuch figures on an extenſive ſcale. For inſtance, how eaſy is it to lay down the plan of any room, or mark out the foundation wall for any building of theſe figures, by firſt drawing a circle equal to their reſpective areas, and dividing the quadrant of that circle into the ſame number of equal parts as the room or building has ſides; and then taking four of thoſe parts for each ſide of the building or room.

From theſe hints the Cabinet-maker alſo will eaſily apply this method to any table-top, or other piece of work that is required to be made of theſe figures.

Of the various Methods of deſcribing Ovals.

Prob. XII. Fig. 22.

To draw an Ellipſis by the interſection of two circles.

Operation.—Let the line B A be the tranſverſe, or long diameter, which divide into three equal parts. Take one of theſe parts for the radii of the two circles, and on the centers *d* and *s* deſcribe the circles interſecting each other at *n n*. Draw from

n a right line through *d* to *b*. From *n* draw *n s* to *e*, and ſo of the other ſide. Place the compaſs foot on *n*, and extending the other to *b*, ſweep the arch *b e*. Laſtly, fix the foot of the compaſſes on the other *n*, and ſweeping the oppoſite arch, the oval will be completed.

PROB. XIII. FIG. 23.

To draw an Oval whoſe tranſverſe diameter ſhall be equal to the diameters of two given circles.

Operation.—Draw C D equal to two diameters of a given circle. Sweep the circumferences of the two circles. Then from the center of each circle, with the compaſſes in the ſame poſition as when the circles were drawn, ſweep two arches, *s d p* and *p o s*, interſecting in the points *s* and *p* *.

To complete the Ellipſis, fix your compaſs foot on *s*, and extend the other to *n*; ſweep the arch *n r*. Laſtly, fix the compaſs foot on *p*, and ſweep the oppoſite arch, and the work is done.

* It is evident that the angles *s d p o* form a rhomb compoſed of two equilateral triangles *d s o*, *p d o*, which method of drawing a rhomb of that degree of inclination is moſt quick and certain. The ſame obſervation might have been made on the firſt oval, but this being more diſtinct, I choſe to mention it here.

The

The method of drawing theſe two kinds of Ovals ſuppoſes that we are only confined to the length of the long diameters, without regard to the ſhort one; but the following Problem is to draw an Oval of any length and breadth as may be required.

Prob. XIV. Fig. 24.

To deſcribe an Ellipſis whoſe tranſverſe and conjugate diameters are pre-determined.

Operation.—Let E F be the tranſverſe, and *a o* half the conjugate. Take *a o* half of the ſhort diameter, and place it on E *d*. Divide then the remaining part of half the long diameter into three equal parts, as the figure ſhews, and take one of theſe three parts and lay it on the other way, as from *a* to *n*. Take the diſtance from *n* to *o*, and lay it from *o* to *g*. Extend then the foot of the compaſſes from *g* to *n*, by which ſweep two arches each way, interſecting each other at *p o*. From *o* to *n* draw a right line out at pleaſure. Do the ſame from *o* to *g*, and alſo from *p* to *n* and *g* on the oppoſite ſide; then will every center be found for each reſpective arch. From the center *n* extend the compaſs foot to E, and ſweep the arch E *b*. Do the ſame from *g*, and ſweep the arch *m* F. Laſtly, from *o* extend the compaſſes to *b*, and ſweep the arch *b m*; and ſo of the other ſide, which will complete the Ellipſis as required.

PROB.

PROB. XV. FIG. 26.

To draw an Oval of any length and breadth by means of two bradauls and a chalk line.

The above methods for drawing ovals ſuit well for ſmall ovals deſcribed on paper, or any kind of metallic ſurface, when very ſmall ovals are wanted to be drawn on wood. But when ovals of a large ſize are wanted, they become inconvenient on account of their centers. Therefore Cabinet-makers generally make uſe of a tramel, by which any oval from two to about four feet may be drawn, both with more diſpatch and accuracy than can be done by any other method. The method, however, which is here propoſed, is not without its advantages, ſince by it an oval may be drawn as large as we pleaſe, both with little trouble and conſiderable exactneſs, provided that materials ſufficiently ſtrong and large enough were ſubſtituted in place of the bradauls and chalk line.

Operation.—Let B D be the length of the oval, and A *s* half the ſhort diameter. Take then half of the longeſt diameter, and place it from A to *a* till it touch the line *a s* exactly at *a*. Again, take the length *a s* and place it on the right hand at the bradaul; then will the two centers be found in which the bradauls are to be fixed. Laſtly, take a line and put it about the

the two bradauls, and bring the ends of the line exactly to A, at which point fix your pencil or piece of thin chalk, and begin to describe in the manner that the hand exhibits, and the pencil, &c. will paſs through the points DBA as required.

I have found the preceding method vaſtly convenient in marking out the circular ends of a ſet of dining-tables; in which caſe there is always an opportunity of ſticking in the bradauls at one ſide of the board, after a line has been ſtruck to make the edge of the board ſtraight. Then, after drawing a perpendicular line by a ſquare and pencil from half the length of your dining-table top, proceed as above, and you may draw the ſemi-ellipſis juſt to ſuit the breadth of the board, if it is ſo required.

PROB. XVI. FIG. 27.

To deſcribe an Oval by Ordinate Lines.

Where an Oval is wanted to be deſcribed on a ſmooth ſurface that will not admit of any inciſion or rough mark, the following method may be recommended.

Operation.—Draw the inſcribed circle in Fig. 27 on a ſeparate board or paper, that the compaſs foot may not mark the ſmooth ſurface. Divide one ſemi-diameter of this circle into

any convenient number of equal parts. From theſe diviſions (ſuppoſe four) raiſe perpendicular lines to the Periphery* or circumference, which are called the Ordinates of that circle. Obſerve, the diameter of this circle is always equal to the conjugate diameter of the oval.—Proceed now to draw a line on the ſuppoſed ſmooth ſurface, on which to determine the length of the long diameter; which divide into the ſame number of equal parts from the center each way as the ſemi-diameter of the circle is divided into. From theſe diviſions draw lines acroſs, as the figure ſhews. Number the ordinates of the circle, as 1, 2, 3, 4, and do the ſame to thoſe of the intended oval. Take then the compaſſes, and fixing one foot in 1 on the circle, extend the other to the point where that line touches the circumference. Transfer this opening of the compaſſes to the lines 1.1 for the oval, and make a pencil mark at the point each way from the diameter. Take the ordinate 2 from the circle, and place it each way from the diameter on the ordinates 2.2 for the oval, and mark the points with a pencil as before. In this way proceed till all the ordinate lines are taken from the circle and transferred to their correſponding ordinates for the oval; after which nothing will remain but to draw a ſmooth curved line through each point, and the oval will be complete.

* Periphery, from περι, *peri*, about, and φερω, *phero*, I bear or carry; which derivation, if I am not miſtaken, alludes to the hand bearing the radius about its center, in order to deſcribe the circumference of the circle.

PROB.

Prob. XVII. Fig. 28.

To draw an Oval by means of a notched piece of wood and a ſquare.

I propoſe this method as a good make-ſhift, where a proper tramel is not to be had, and when, perhaps, the method of drawing ovals by the foregoing rules may have eſcaped the memory, and no book near at hand to aſſiſt it.

Operation.—Let *f i* be the long diameter, and take any ſquare, by means of which draw the line *e t* at right angles, or ſquare with it. Then notch out a piece of thin deal, as *a g*, to ſuit the thickneſs of the ſquare, ſo that the bottom of *g* may reſt on the ſurface of the oval, and not prevent *a* from paſſing in the circumference *f e*. From the pencil point near *a* to the end near *g* muſt be equal to half the long diameter *g f*, and from the notched part *a* to the pencil point *a* muſt be equal to half the ſhort diameter *e g*. Laſtly, place your ſquare, and with one hand keeping it unmoved on the two diameters, by the other ſweep the elliptic arch *e f* for one quarter. How to proceed to the other quarters muſt be evident to every one, and therefore it is unneceſſary to ſay more.

The truth of this method will appear to every one by

obſerving, that if *b*, which is the end of the notched wood or tramel ſtick, is moved gradually to *g*, the internal angle of the ſquare, then will the pencil point be at *f*, becauſe from *b* to the pencil point is equal to *f g*, half the long diameter: and again, if *a*, at the notch, be gradually turned to *g*, the inner angle of the ſquare, then will the pencil point be at *e*, becauſe from *a* to *a* is equal *g e*, half the ſhort diameter.

I have already ſhewn the method of drawing an oval by the ſector in Section II. page 38, and therefore I need not ſay any thing on it here.

PROB. XVIII. FIG. 30.

To find the center and two diameters of any Oval whoſe circumference is already given, and whoſe center and diameters are eraſed or rubbed out.

Operation.—Let *m i q g* be the circumference of the oval.

Draw the right line *o q* at random, and draw *m n* any where parallel to *o q*, by means of two arches, as the figure ſhews.

Second, Biſect the line *m n* from its interſection with the circumference of the oval, as at *s*. Alſo biſect *o q* in the ſame manner

manner as at *s*. Draw the line *i g* through *s s*, and from where *i g* cuts the oval, bifect *i g*, as at the center *s*.

Third, On the center *s* defcribe any circle large enough to interfect the circumference of the oval, as at the points *c b*. Draw the line *c b*, and bifect it, as at *u*; then draw the long diameter *a b* through *u s*, the center; and, laftly, draw *e d* parallel to *c b*; then will *e d* be the fhort diameter, *a b* the long one, and *s* the center, as required.

This Problem will be found ufeful in many cafes. For inftance, when the face of a fire fcreen is a true oval, and it is required to put the brafs fprings on it after being covered with paper or filk, &c. in this cafe it will be very uncertain whether the oval will hang true, if the fprings are only put on by guefs.

To avoid uncertainty, take a fheet of paper and lay on the face of the fcreen, drawing a pencil round its circumference, from which proceed to find the diameter as above.

PROB. XIX. FIG. 17.

To find the Center of any fegment or complete circle whofe circumference is already given.*

Operation.—Let B D A be the fegment whofe center is required.

quired. Draw the chord lines A D, D B, any how at random. Bisect the chord A D by sweeping two arches from the points A and D, as the figure shews. Do the same to D B. Lastly, draw the right lines *e d* and *a b* through the intersections of those arches, and where these two lines meet in a point, as at *c*, will be the center as required.

It is evident, if *c* be the true center of the segment B D A, that it will also be the true center of any complete circle of the same radius.

It is likewise farther evident, that if the chord lines A D and D B were considered as two sides of any regular polygon, the same method would have the same effect in finding its center.

The above Problem will be of use to the workman, when it is required of him to fit up a board into the inside of an arch, in order to ascertain its true sweep.

To this end, let the line B A represent a lath laid across the foot of the arch A D B, to find the length of its opening. Then find the middle of this lath, and from the middle of it put up another perpendicular to it, as D, to find the depth of the arch. After having proceeded thus far, take the board to be fitted up, and make one edge of it straight, and draw a

ſquare line acroſs it, on which lay on the depth of the arch, as at the point D. From D draw the chord lines DA and DB, biſecting them as has already been taught, and the true center will be found for the ſweep of the arch; which ſweep, if it be exactly ſawn, will fit the arch ADB, as required.

Prob. XX. Fig. 18.

To find the Diameter of a Cylinder, when its ends cannot be meaſured, or of a circular building, when no dimenſions can be obtained from its inſide.

Operation.—Let the circle, Fig. 18, be conſidered as the circumference of the cylinder, and let *h k* repreſent a ſtraight rod, touching the outſide of the cylinder. From any of the diviſions on the rod *h k* put another rod acroſs, till it touch the outſide of the cylinder in a ſquare direction from the rod *h k*; which is eaſily done, by keeping the croſs rod exactly by the ſide of the ſquare lines which mark out the diviſions. So the lines *g h* and *i k*, repreſenting the croſs rod, are in a ſquare direction from the long rod, and are produced till they touch the cylinder.

After proceeding thus far, take paper, or a drawing-board, as may be required, and draw a right line equal in length to *h k*,

as

as *b m k*, No. 2. From *b m k* draw *g b* and *i k*, of the ſame length and direction, as *g b* and *i k* in Fig. 18. Draw then the chord line *g m* at random, and from the point *m* draw *m i*, the other chord. Biſect thoſe chords, as the figure ſhews, and where the right lines meet in a point will be the center of the cylinder; and any right line being drawn through the center *s* will determine the length of the diameter as required.

Thus it is evident that the diameter, and conſequently the circumference of any round building, may be aſcertained by this method.

The lath *b k*, in ſuch a caſe, may be conſidered ten feet long, and five inches broad, and each of the diviſions on it one foot: and proceeding in the manner taught above, the moſt accurate dimenſions of the diameter of any ſuch building will be found.

SECTION V.

On various useful Problems pertaining to the working Part of both the Cabinet-making and Upholstery Branches: as the Methods of mitring Mouldings of different Projections—of drawing large Circles, without the Trouble of extending a Lath to their Centers, to sweep their Circumferences by—of drawing sweep Cornices, and fitting up their Valances to the Cornices—of mitring the raking Mouldings of Pediments—and of the Manner of planing a Room to cut a Carpet by.

PROB. XXI. FIG. 15. Plate II.

THE extreme lines P E and P 1 being given, let it be required to find any number of mean proportional lines at equal distances from each other.

Operation.—From the points of the extreme line E P to the points 1.1 of the other extreme draw right lines which will meet in O. Then let it be required to find eight mean proportionals, placed at equal distances from each other. Divide the extreme line P E into ten equal parts, which is allowing one part

part for each extreme. Draw the line *i* 9 parallel to the line PO, cutting EO in 9. Again, draw *h* 8 in the ſame manner, cutting EO in 8; and ſo of all the reſt, as 7, 6, 5, 4, 3, 2, 1. Through each of theſe points 9, 8, 7, 6, &c. draw lines parallel to PE, as the figure ſhews; then will the lines 9.9, 8.8, and ſo on, be the mean proportionals as required.

Obſerve, in whatever proportion the extreme line EP is divided, into the ſame proportion will the hypothenuſe line EO be divided when lines are drawn parallel to the baſe line PO from the reſpective diviſions on EP. Therefore if E *h* be one-fifth part of the line EP, then is *h* 8 one-fifth of the baſe line PO, and E 8 one-fifth of the hypothenuſe EO. Alſo if E *c* be nine-tenths of the line EP, ſo will a line from 1 to E be nine-tenths of the line EO, and the perpendicular line 1.1 will be one-tenth of the line EP; ſo the line 2.2 will be two-tenths of it; and ſo on proportionally of all the reſt.

From this little theory, the following practice may be deduced.

If it be required to make a ſtep-ladder of inclined ſides, as they generally are, or any thing of the ſame nature, it is evident, from what has been ſaid, and from what may be ſeen in the figure, that the ſteps may all be cut to their proper lengths, before

before the ladder be put together in any part of it, which of courfe faves both wood and time.

To cut the fteps to their proper length, proceed as follows. Take a piece of deal, two or three feet long, and plane it over, making at the fame time one of its edges ftraight. Then determine how much the ladder is to bevel off from bottom to top. Take the difference, and having drawn a fquare line from the ftraight edge of the board, place the beveling difference, fuppofe fix inches, upon this line, which, in the figure, is reprefented by the line E P. Draw a line, as from E to O, fuppofe fix inches in length. Draw then the center line of each ftep from the edge of the board, at equal diftances, as the line 9.9, 8.8, &c. then will the difference of the lengths of thefe perpendicular lines be equal to the difference of the length of each ftep; that is, the ftep 8 will be the fpace between *i* and *b* fhorter than the ftep 9, and fo on to the laft ftep 1.1, which will be all the fpace between *i* and *c* fhorter than 9, as is evident from infpecting the figure.

To find the bevel of the ftep-ends, divide E P, fuppofe fix inches, in the fame ratio or proportion as the fide of the ladder is divided into. If the fide pieces of the ladder be ten feet long, take one foot and place it by the edge of the before-mentioned board. Then divide the bevel of both fides of the ftep-

ladder, ſuppoſed to be ſix inches, into ten, and take one-half of the tenth of the ſix inches, and a line to a full foot in length will give the true bevel for all the ſteps. Laſtly, when the ſteps are all plained, run a gage on the middle of their edges: upon this gage ſtroke muſt be placed the different lengths of the ſteps, and the bevel for their ends muſt be ſtruck acroſs from their reſpective extremities.

Thus it will be evident to any thinking workman, that all the ſteps may be finiſhed for putting together before the ſides of the ladder are begun; and how to proceed with theſe need not be mentioned.

From the above little theory may alſo be deduced a uſeful practice in perſpective, when vaniſhing lines exceed the picture; but this muſt be reſerved for the ſecond part of this work, in which I ſhall treat of that art.

PROB. XXII. FIG. 29. Plate III.

To draw an Elliptic Cornice of any given length or depth, and to fit the valance to it.

Operation.—Let *o p* be the depth of the cornice with its facia, and make *o* 10 half the length of the cornice; draw the quadrant

quadrant *p* 2, and divide its chord into nine equal parts, from whence draw lines perpendicular from the base of the quadrant till they cut the circumference. Divide then the half length of the cornice into ten, and draw perpendiculars from each respective division, marked 1, 2, 3, 4, &c. From the divisions or points on the circumference of the quadrant draw lines parallel with the base line 10 *o*, till they cut the perpendicular line to which they belong; that is, from 8 on the circle draw a parallel line till it touch the perpendicular 8, and from the rest do the same, which will form so many points on the respective perpendiculars as will be a sufficient guide for an elliptic arch to pass through. Observe, the ninth division is subdivided, by which another point is gained in the quick part of the ellipsis, for the convenience of drawing the sweep more perfectly. The proportion of the hances may be easily ascertained, as the figure shews; but in this particular fancy will generally be the rule.

Method Second.

It has already been observed, that the chord line of the arch 2 *p* is divided into nine equal parts, from which lines are drawn till they touch the circumference; after which draw the line *p* 9, as a correspondent chord for the elliptic curve, and divide it into the same number of equal parts as the chord of the circle is divided into. Then take, for instance, the length of

the perpendicular line 8.8 in the circle, and transfer this to the perpendicular line 8 on the other chord, and mark it with a pencil. Again take 7.7 from the chord of the circle, and transfer it to 7 on the other chord, and mark it as before. In this way proceed till all the perpendicular lines on the chord of the circle are placed on the correfpondent perpendiculars on the elliptic chord, and nine points will be obtained through which the curve is to pafs as before.

To fit up a Valance to a Cornice of the above Kind.

The ftuff for the valance fhould be tacked ftraight on a board, and with a piece of foft chalk draw a line anfwerable to the line 10 *o*, or bottom of the facia. Divide the facia of the cornice in the manner fhewn in the figure, and draw fquare lines up to the cornice: do the fame on the ftuff for the valance, and take from the cornice the length of each perpendicular line *o*, 1, 2, 3, &c. &c. and transfer thofe different lengths to their refpective perpendiculars on the ftuff, and mark them with chalk. Laftly, by a fteady hand draw, with foft chalk, a curve to pafs through thefe points, which, if accurately done, and cut by the line, muft evidently fit at the firft trial.

PROB.

PROB. XXIII. FIG. 31. Plate III.

To defcribe the Arch of a Segment of a large Circle, without the affiftance of a lath from its center.

Operation.—Let Fig. 31 be confidered a fegment, whofe chord is twenty feet long, and its fwell two feet, as the perpendicular C 10. Draw then a femi-circle, whofe radius fhall be equal to C 10. Divide one quadrant into ten equal parts, and into the fame number divide half the chord A C. From each divifion on A C raife perpendiculars, as 1, 2, 3, and fo on. From 9 on the quadrant draw a line parallel to A C, till it touch the perpendicular 9, and mark it with a point. Again, from 8 on the quadrant draw a parallel till it touch the perpendicular 8, and mark it as before; and fo on, from 7 to 7, 6 to 6, till the whole are done. Through the points on the feveral perpendiculars draw, with a fteady hand, a curve line paffing through thefe points, and it will form a regular arch.

Method Second. (On the right hand of Fig. 31.)

Operation.—Draw the chord of the quadrant, and divide the fame chord into ten equal parts, and raife from thefe equal divifions lines perpendicular to the chord, till they touch the quadrant

quadrant arch. Divide the line C B into ten equal parts alſo, and from 10 perpendicular to C, draw the line 10 B. On the chord of the quadrant take your compaſſes, and fixing one foot on the perpendicular 9, extend the other foot to the point where the ſame perpendicular touches the arch. Transfer this to the other 9, and make a pencil mark. Again, place one foot of the compaſſes on 8 of the chord of the quadrant, and extend the other foot to the point where the perpendicular cuts the arch. Transfer this alſo to the other 8, on the line 10 B; and in this way proceed for all the reſt, drawing a curve line through the reſpective points thus found, which will form a regular arch as before.

PROB. XXIV. Plate IV.

To take the Plan of a Room in an accurate manner, ſo that a Carpet may be properly cut by it.

Operation.—The room being cleared of every obſtruction, and the floor ſwept clean, proceed as follows:

Firſt, Take a chalk line, and by it ſtrike a line parallel to that ſide of the room which ſeems freeſt from irregularities, as *d c*, in Plate IV. Then by Problem III. page 23, raiſe a perpendicular from *c* continued to *b*. Proceed next to the other end of the room, as at *d*, and by the ſecond method of Pro-

blem III. if moſt convenient, raiſe another perpendicular continued to *a*. Draw then a line from *a* to *b*, exactly parallel to *d c*, the oppoſite ſide of the room. Then will the angles *a b c d* form a true Paralelogram, proportioned to the ſize of the room, by which the principal diſtortions or irregularities of any of the ſides of the room will at once appear. For inſtance, the angle *v* is ſomewhat out, as the line parallel to *a d* plainly ſhews: and in this manner any other angle of the room, whether obtuſe or acute, may be aſcertained.

Second, Let the hexagon end of the room be next conſidered; and let it be obſerved, that the plan-taker is ſuppoſed to have no ſquare, or ſtraight rule, but only a caſe of inſtruments and line. Therefore, in order to know how much the ſide *i l* bevels off from a ſquare, take the line and ſtrike it by the ſide *i l* of the hexagon, and continue the line at pleaſure beyond *h*. Take then the braſs protractor, and place the center of its baſe to *i*, as the figure ſhews. Make a pencil mark over 90, on the arch of the inſtrument, and from *i* draw a ſtraight line acroſs the pencil mark to *g* at pleaſure. Take the ſide *i l* of the hexagon, and place it from *i* to *h*. Draw *g h* parallel to the baſe of the protractor, or to *b c*; then will *g h* ſhew how much *i l* is out of ſquare, as required. Examine then the other ſide of the hexagon by the ſame rule, and if there be any variation from the oppoſite ſide, it will eaſily be diſcovered by the ſame rule.

Proceed

Proceed to the windows, and find the rake of the jambs in the fame manner as before, which needs not be repeated: only obferve, that the protractor cannot be placed to the architraves becaufe of their irregularity; and therefore it muft be placed on the line *a b*, as the figure itfelf expreffes.

Laftly, Proceed to the circular end of the room, with its windows; and in order to find the center of the arch *r o p*, draw *p v* at its foot, and parallel with *a d*. On the middle of *p v* raife a perpendicular, and continue it to *t* at pleafure. Draw then the chord *o p*, and bifect it, whence raife a perpendicular, cutting *o t* in *t*, which will be the center. From the opening of each window draw the feveral radii, as fhewn in the figure, by which it will be eafily feen how much the jambs vary from thefe central lines.

The room being thus lined out, take a fheet of paper, and lay down a fcale of feet and inches that will comprehend the longeft part of the room. Meafure then with your common rule the fides and ends of the Parallelogram which was chalked out on the floor, and whatever thefe meafure by the rule, take the fame number of feet, inches, and parts from the fcale, and draw the Parallelogram on the paper in the fame manner as was done on the floor: and in this way go on, taking off every dimenfion from the floor by the rule, and transferring them

to

to the paper by the ſcale; ſo that at length the paper will have all the lines and ſhapes which the room has, by which means it is evident that the moſt exact meaſurement will be obtained.

The next thing to be done is to provide a place large enough to lay down the full ſize of the room again. The order will now be reverſed at home; for thoſe meaſurements which were before taken from the room by a rule, and tranſferred by the ſcale on the paper, muſt again be taken from the paper by the ſame ſcale, and replaced on ſome convenient place, by the ſame rule that was uſed in taking the plan. If this method be purſued with accuracy, I am certain it cannot fail to anſwer the purpoſe, if a proper allowance be made for ſtraining the carpet.

PROB. XXV. FIG. 32. Plate V.

To mitre any thing of the nature of a Comb Tray, the breadth of whoſe ſides ſhall be given, and their inclination from a perpendicular predetermined.

Let *b a* be conſidered equal to the given projection of the ſide of the tray, and let the perpendicular *e a* be the height of the ſpring of its ſides. Draw the bevel line *e b*, and fixing one foot

 of

of the compaſſes at *b*, ſweep the arch *e d*; then will *d* on the baſe line be the mitre point of the ſide of the tray *g l*, and *d b* will be the required breadth of its ſides, neceſſary to raiſe it to *e*, perpendicular over *a*, the point of projection. Again, if the tray ſide ſhould be required to be raiſed from its baſe up to *m*, then draw *m b*, which will be the breadth of the ſide, and with *b m* in your compaſſes, ſweep the arch *m n*; then will *n* be the mitre point of the ſide of the tray, as required. How much ſhorter the point *n* is than a full mitre, is ſeen from *n* to *o*, of the dotted lines meeting together.

Whence it is evident, that as the tray ſides are raiſed higher and ſtill higher from their baſe, the mitres will become proportionably ſhorter, till at length the ſides will be in an upright poſition, and conſequently muſt ſtand in a perpendicular direction from their baſe or bottom. On the other hand, if the ſides of the tray be depreſſed nearer to their baſe, and ſtill nearer, their mitres will proportionably increaſe, until they arrive at full length, and conſequently they will be in a perfect horizontal poſition, or parallel to their baſe.

A little reflection will eaſily convince the reader, eſpecially the Cabinet-maker, of the propriety and uſefulneſs of theſe remarks. How the edges of the ſides of the tray are to be bevelled to ſuit their rake, muſt be evident by inſpecting the figure,

figure, and is generally known by all workmen, and therefore it is unneceſſary to dwell further upon it.

PROB. XXVI. FIG. 33. Plate V.

To find the Lines for working the Mouldings of a Clock Bracket, &c. when the front moulding projects more than the ends.

Operation.—Let *a o b d* be the plan of the clock bracket. From the center of *a o* draw the mitre lines to *b* and *d*, and from the center let fall a perpendicular, as at *f*. From this perpendicular draw a profile of the cavetto and aſtragal, according to the projection intended for the ends of the bracket. From the ſpring of the cavetto on the top of the necking raiſe a perpendicular up to the line *a o*; then from the upper part of the cavetto, as from 1, raiſe another perpendicular up to 1 on *a o*. From where theſe perpendiculars interſect with the mitre line, divide the intermediate ſpace into any number of equal parts, as at 1, 2, 3, 4. From theſe numbers on the mitre line draw perpendiculars up to the correſpondent figures on *a o*, and continue them downwards till they touch the cavetto at 2, 3, 4. Laſtly, draw from the utmoſt projection of the aſtragal or necking, a perpendicular, cutting the mitre line at 5; then from 5, 4, 3, 2, 1 on the cavetto draw parallels out at

 pleaſure.

pleaſure. Take in your compaſſes *d o* from the plan of the bracket, and place it from *d* to *p*, No. 1. From *p* let fall a perpendicular; then from the plan, as before, take 1.1 and place it from 1 on the perpendicular line *p* to 1 on the parallel line. Again, take the line 2.2 from the plan, and place it on the parallel line 2 to 2, and ſo of all the reſt, forming ſo many points, by which a profile of the front cavetto may be formed, and which will mitre in with the end cavetto, if the mouldings are exactly worked to theſe profiles, and the mitres be accurately cut. How the mitres are to be cut is eaſily ſeen by the mitre lines on the plan.

In Plate II. Fig. 12, an example of the ſame kind is ſhewn, as it may be performed by the Sector.

Let the quadrant A D be conſidered as one of the cavettoes to be mitred together. Then let it be propoſed that another cavetto is to mitre to the former, whoſe projection ſhall be equal to 1.10. Proceed then to draw this cavetto by the ſame directions as are given in page 39 for drawing an Oval; after which the cavettoes are to be worked according to theſe curves. The length of the mitre for the leaſt projecting cavetto is from 90 to 10, and that of the largeſt projecting cavetto is from 10 to A, and the mitre line is 9.10.

By theſe methods it is evident, that any moulding of different projections, and conſiſting of various members, may be worked, and cut ſo as to mitre exactly together.

PROB. XXVII. FIG. 34. Plate V.

Of working and mitring raking Mouldings.

Let No. 1, Fig. 34, be a level ovolo in a broken pediment. Make its projection equal to its height. Divide the height of the ovolo into any number of equal parts, and from theſe diviſions draw parallel lines, as is ſhewn in the figure. Next, from the extreme points of the ovolo draw two parallel lines, according to the rake of the pediment deſcribed below, which will of courſe increaſe the height of the ovolo. Draw then a perpendicular or ſquare line from either of the raking lines, as at No. 2. Divide this ſquare line into the ſame number of equal parts, and from theſe diviſions draw lines parallel to the raking part. Take then 5.5 from No. 1, and transfer this opening of the compaſſes to 5.5 on No. 2, and make a pencil mark where it extends to. Again, take in your compaſſes 4.4, from No. 1, and transfer this alſo to 4.4 on No. 2, and mark it as before; proceeding in the ſame manner with the reſt; by which points will be found to enable us to draw the raking ovolo ſo that it will mitre with the level one at No. 1. Laſtly, if a pediment be

be open, then it will require returning mouldings to mitre in with the raking mouldings in front; for which returning members there muſt be another drawing made, as No. 3. The fillets, &c. of theſe returning mouldings ought to hang perpendicular with the level cornice; therefore draw, at No. 3, a line perpendicular with the level cornice. Raiſe then another perpendicular at a diſtance from that which was firſt drawn, equal to the projection of the level ovolo, as is ſhewn by the dotted line in No. 3 of Fig. 35; and from the point where this perpendicular cuts the raking line, draw a line parallel with the level cornice, which gives the whole breadth of the returning moulding, as is apparent by inſpection.

Divide the whole breadth of the returning ovolo into the ſame number of equal parts as before, and proceed exactly in the ſame manner to find the curvature of the returning ovolo as was done to find that of the raking one, and the whole by theſe methods may be completed.

In the ſame manner may be found the raking and returning cyma-recta mouldings, deſcribed in Fig. 35, which it is unneceſſary to ſay any thing about, after what has been ſaid on the ovolo.

PROB. XXVIII. FIG. 36. Plate V.

As I have in this Section defcribed the methods of drawing and mitring mouldings of different projections, and alfo of drawing and mitring raking with level mouldings, it may be proper here to defcribe the proportion of the Tufcan raking Pediment, and the manner of drawing it.

It is true, according to an orderly arrangement, the Pediment fhould come after the column; but this is of fmall confequence, if it can as well be underftood in this place.

The intention of a clofe pediment, whether raking or circular, is not only to ornament the front door or entrance of any building, but likewife to fhelter fuch as feek admittance from inclement weather. For this purpofe the raking clofe pediment of any order is beft calculated; for whilft we are fheltered from rain or fnow by the bold projections of the feveral members of each order, efpecially the Doric, the defcending fhowers eafily and quickly glide off on each fide, on account of the rake of fuch pediments.

It is therefore improper to have open pediments of any order at the exterior entrances of buildings: and it is con-

fidered by architects as improper to have clofe ones over interior entrances or door ways, where they are only employed as ornamental.

The pitch of the Tufcan pediment is the fame with the other orders, for in this refpect they are all uniformly the fame; but their intercolumniations, or fpaces between the pillars or pilafters, together with other particulars, vary according to the refpective order to which they belong; which I fhall mention afterwards, in treating on the Orders.

To proportion and draw the Tufcan order, proceed thus:

Obferve, that Fig. 36 is exactly half the pediment only; and therefore, in drawing a whole pediment, the divifions fpecified in the figure muft be laid on each way from the central line. And obferve likewife, that the frieze and architrave are not drawn to the cornice, becaufe they are not wanted in defcribing the pediment.

Operation.—Lay down three diameters from the center of the pediment to the center of the fhaft, as at 1, 2, 3, in the figure. Divide a diameter into eight equal parts, and take three of thefe and place them each way from the center line of the fhaft, which gives the upper diameter of the column, as the

the figure ſhews. Again, divide a diameter into four, as that diſtinguiſhed by the writing in the figure, and take three of thoſe parts for the perpendicular height of the cornice: at this height draw a parallel line at pleaſure ſufficient for the whole length of the pediment, as the upper line with the numbers. Then take the perpendicular height of the cornice, and place it from the outſide line of the ſhaft on the line continued out from the under edge of the cornice, which will determine its projection, as is eaſily ſeen by the level ſcale line *b*. Raiſe a perpendicular line from the whole projection, as *g*, till it cut the upper parallel line; then will this line ſerve as a ſcale for the heights of each member in the cornice, the proportions of which are eaſily ſeen by the aliquot parts on the ſcales; but if not rightly underſtood, the reader may ſuſpend his judgment till the Tuſcan order is deſcribed.

Divide the upper parallel line, which is equal to one-half of the whole length, into nine equal parts, and give four of theſe for the pitch of the pediment, as the figures 1, 2, 3, 4, ſhew. Draw then a right line from 4 to the utmoſt projection of the level cornice, and proceed to draw each member of the level cornice, as the ſcale lines direct.

Note, The two upper lines, containing the nine diviſions, repreſent the upper fillet of the level cyma-recta.

The next thing to be done, is to proportion the members of the raking cornice by thoſe of the level one. To do this, draw a ſquare line from the pitch of the pediment, and continue it till it paſs through the level cornice. Take then the ſkew meaſurement of the lower fillet of the level cyma-recta, as *a b*, and transfer this to the raking cyma-recta downwards, from *a* to *b*. Again, take *b c* from the level corona, and tranſfer it from *b* to *c* for the raking corona. Laſtly, take *c d*, *e f* in the ſame manner, and transfer them one after another for the raking mouldings, as before; after which, draw lines through the ſeveral points parallel to the pitch or raking line, and the pediment will be completed for ſhading if required.

SECTION VI.

Of the Names and Properties of various Geometrical Solids—Of finding curved Lines to anſwer the Sections of various irregular Figures—and of the Nature and Conſtruction of Hip and Elliptic Domes.

In Section III. page 43, I have there obſerved on uſeful geometrical ſuperficies, that to have ſome knowledge of their names and properties is certainly of advantage to every one, eſpecially to thoſe who are concerned with drawing or making pieces of work of the like figures.

With equal propriety the ſame may be affirmed of the uſeful geometrical ſolids, the knowledge of whoſe names and properties frequently enable us to communicate our ideas of the figures of various objects that occur to us, with greater preciſion and freedom than we otherwiſe ſhould be able to do, were we, for want of this knowledge, obliged to uſe a number of explanatory words and ſigns before we could be underſtood.

However, I have not introduced more of theſe than what I think quite neceſſary to be known, and which I ſhall now endeavour to explain in as ſhort and clear a manner as I am able.

Of the Names and Properties of the General Solids.

In Plate VI. No. 1 is termed a Cube, which is a regular ſolid, bounded by ſix equal geometrical ſquares or ſurfaces, from Κυβος, *kubos*, a dye. It is alſo called by ſome a Hexaedron*, becauſe it has ſix ſeats or baſes on which it is capable of being reſted.

No. 2, is a Parallelopipedon, or Parallelopiped, a regular ſolid, contained under ſix parallelograms, whoſe oppoſite ſides are parallel and equal; or it is by ſome called a Priſm, whoſe baſe is a parallelogram.

If a piece of wood be ſeven or eight inches long, three broad, and two and a half in thickneſs, ſo planed that its ſides are all parallel, and cut ſo that its ends are ſquare to its ſides, then will the piece of wood be of the figure of a Parallelopiped.

* Hexaedron, from ἑξ, *hex*, ſix, and ἑδρα, *hedra*, a ſeat.

No.

No. 3, is a Pentangular Prifm *, fo called becaufe its ends are bounded by pentagons, or five-fided furfaces, and its fides by five parallelograms.

There are various kinds of Prifms; as No. 4, is an Hexangular; No. 5, a Trapezoidical; and No. 6, a Triangular Prifm.

An Hexangular Prifm is terminated at its ends by two fix-fided furfaces, and its fides by fix parallelograms.

If a piece of wood, feven or eight inches long, be rounded to two or three inches diameter, and if this piece of round wood be planed fo as to have fix fides parallel to each other, then it will be of the figure of an Hexangular Prifm.

Again, a Trapezoidical Prifm is one which is bounded at its ends by two Trapezoids, (fee No. 5, Plate II.) and whofe fides are four parallelograms, two of which are equal to each other, but not parallel, and two unequal in width, yet parallel.

If a piece of wood be feven or eight inches long, as before, and if one of its fides be about three inches broad, and two of them two inches and a half, inclining or beveling off alike

* Prifm, from πρισμα, "fomething fawn or cut off."

from

from the side which is three inches, reducing the fourth side to *two inches broad*, then will the piece of wood be of the figure of a Trapezoidical Prism.

Lastly, the Triangular Prism is so called, because its ends are bounded by triangles, or three-sided superficies, and its sides by three parallelograms.

If, as before, a piece of wood be planed so as to have three sides, suppose each two inches broad, and their angles parallel, it will then be of the figure of a Triangular Prism.

No. 8, is a Tetrahedron*, called so because it comprehends, and is bounded by four equilateral † triangles. It may also be conceived as a triangular pyramid of four equal faces.

Hence, if a piece of wood be first cut into the form of an equilateral triangular prism, and then be terminated from its base till the three sides meet in a point perpendicular to the center of the base, and if the terminated or inclined sides be equal in length to their base, then will the wood exhibit the figure of the geometrical solid, termed a Tetrahedron.

* Tetrahedron, from τέτρα, *tetra*, four, and ἕδρα, as before.

† See Plate II.

No.

No. 7, is an Octahedron. It receives its name from the eight equal and equilateral triangles by which it is bounded. It may alſo be conceived as two quadrangular pyramids, joined together at their baſes.

If, therefore, a piece of wood be formed into an equal quadrangular priſm, and if this priſm be terminated from its center each way, till all the ſides come to a point perpendicular to the centers of the reſpective baſes of the pyramids ſuppoſed to be joined together, then will the piece of wood, thus cut, give the true figure of an Octahedron.

No. 15, is a Dodecahedron, a regular ſolid, bounded by twelve pentagons.

To form or conſtruct this regular ſolid, a piece of wood may firſt be turned round, and then planed into ten equal ſides. Draw then a regular pentagon (Plate II. Fig. 19) on each end of the piece of wood, one of whoſe ſides ſhall be equal to one of the ſides which the wood was firſt planed to. Laſtly, make five faces on each end of the wood, which ſhall comprehend two of the firſt-mentioned ten ſides, and one of the ſides of the regular pentagon drawn on each end; then will the piece of wood form the figure of a Dodecahedron, as required.

No. 16, is an Icoſahedron, which is a regular ſolid, compoſed of twenty equilateral triangles. See Plate II. Fig. 7.

This figure may be conſidered as conſiſting of twenty triangular pyramids, as No. 8, whoſe vertexes meet in the center of a ſphere, imagined to circumſcribe it, and therefore muſt all have their heights and baſes equal.

To conſtruct this ſolid, a piece of wood ſhould firſt be made round, and then planed into ſix equal ſides. Upon each ſide draw an equilateral triangle, and the ſpaces between each triangle muſt be cut away to the ſide of the triangle thus drawn, and when this is done, there will then be four more planes or faces for four more equilateral triangles, which will make ten. Find the center of one end of the piece of wood, and terminate each ſide of the hexagon to this center, and there will be produced ſix more equilateral triangles, which added to the other, make ſixteen. Find the center of the other end, and terminate the before-mentioned four ſides to this center, and other four equilateral triangles will be produced, which will complete the twenty as required.

From what has been ſaid, it is evident that five of theſe ſolids are regular, ſince they may each of them be inſcribed within a ſphere, ſo that each angle ſhall touch the circum-

ſcribing

ſcribing ſphere in ſome point. Hence, to form theſe regular ſolids, namely, the Cube, Octahedron, Tetrahedron, Dodecahedron, and the Icoſahedron, it is preſuppoſed in the above conſtructions, that the pieces of wood mentioned are all cubes, whoſe ſides are equal to the dimenſion of each figure.

No. 13, is a Pyramid, a ſolid, whoſe ſides riſe from a geometrical ſquare as its baſe, and terminate in a vertical point.

As the height of this ſolid is at pleaſure, its ſides are ſometimes bounded by equilateral triangles, and ſometimes by iſoſceles, as the figure referred to.

Nor are we to confine our ideas of Pyramids to ſuch only as have ſquare baſes, for theſe may be either triangular or polygonal, while yet their reſpective ſides ſhall terminate in a point perpendicular to the center of their baſes.

The learned are divided in their opinions about the derivation of the term Pyramid: ſome think the name is from πυρ, *pur*, fire, becauſe Pyramids aſcend to a point like fire; but others more confidently affirm, that it is from πυρος, wheat, or corn. "Not," ſays the author of this laſt opinion, "that we are to ſuppoſe that the Pyramids were ever intended for granaries; but that the Greeks, when, after many generations,

they visited Egypt, and saw those amazing structures, looked on them as store-houses for grain; and knowing Egypt to be a country fruitful in corn, they called them Pyramids—corn store buildings; being, as they thought, the repositories for all the produce of Egypt."

No. 9, is a Cylinder. This is a solid, bounded by two equal circles at its ends, and a parallelogram revolving round their circumference. This figure is fitly represented by a garden roller, whence its name κυλινδρος, *kulendros*, a roller; and as for its construction, it is so simple that it is unnecessary to say any thing about it.

No. 12, is a Cone; a solid, bounded by two superficies, one of which is convex, and the other straight.

The base of a Cone is sometimes an ellipsis, and sometimes a circle terminating to a point perpendicular to its center. From this center to its vertical point, a line is supposed to pass, called its axis, on which this body might be made to revolve. And the same may be observed of the Cylinder, Conoid, and Sphere, each of which has its imaginary axis, or right line, passing through its center, about which they may be made to turn.

No. 14, is a Conoid; a ſolid, which terminates from its baſe to its vertical point in a curved or elliptic direction. Sometimes the curve of its ſide is hyperbolic, and ſometimes parabolic. See Plate II. Fig. 35, 36.

Its baſe, like the Cone, is either an ellipſis or circle.

No. 10, is a Hemiſphere*, which is one-half of a globe cut by a plane paſſing through its center, and therefore is contained under two ſuperficies.

No. 11, is a Sphere, or whole globe, which is a body or ſolid, bounded by one convex ſurface, whoſe parts are all at the ſame diſtance from the central point, as the perifery of a circle is to its center.

Of the Sections and Coverings of regular and irregular Figures; and how to find curved Lines to anſwer their various Sections.

The Section † of any ſolid is, when it is ſuppoſed to be cut by any plane paſſing in ſome direction through it, which,

* Hemiſphere, from σφαιρα, *ſphaira*, a globe or ſphere, and ημισυς, *hemiſus*, half, i. e. half a globe.

† Section, a cutting or dividing; "from *ſeco*, to cut."

of

of courſe produces a ſurface or ſuperficies conſonant to the nature of the ſection, and agreeable to the ſhape of the ſolid which is cut.

Hence, if a cylinder be cut oblique to its baſe, this ſection will produce a ſurface perfectly elliptic; and if a cone, Fig. 12, Plate VI. have a ſection parallel to its axis, the curved boundaries of the ſuperficies will be hyperbolic. See page 52.

"If a ſphere be cut in any manner, the plane of the ſection will be a circle, whoſe center is in the diameter of the ſphere."

But if two plains, or ſtraight ſurfaces, cut each other, their common ſection is a right line.

I mention theſe particulars, that the reader may more readily and clearly underſtand the following Problems.

PROB. XXIX. FIG. 32. Plate VI.

Let Fig. 32, Plate VI. be conſidered a ſolid, of the ſhape of a vaſe, whoſe covering and ſection are to be found; or, in other words, if a vaſe is required to be veneered, how to cut the veneer ſo as each joint ſhall appear ſtraight when the veneer is laid.

Operation.

Operation.—Draw the ſhape of the vaſe, which, in this caſe, is a ſemi-ellipſis on the conjugate diameter. Draw a perpendicular line through the center of the vaſe, which will be the long diameter. Divide this diameter into a number of equal parts, and on theſe diviſions draw lines parallel to the conjugate diameter, as the figure ſhews at 1, 2, 3, 4, &c. Draw then on each of theſe right lines a ſemicircle, and, for the ſake of greater accuracy, let the eighth ſpace be ſubdivided, by which another circle will be obtained near the center, as at 9. Draw next a perpendicular line at pleaſure, as at No. 1. Proceed then to take the dimenſions of the curvature of the vaſe thus: Place one foot of the compaſſes on 10, and extend the other to 9, and with the ſame opening of the compaſs fix one foot on 10, in No. 1, and ſweep the arch 9 at pleaſure. Again, fix the compaſs foot on 9, and extend the other to 8 on the vaſe, which transfer from 9 to 8 at No. 1, and opening the compaſſes, fix one foot on 10, and with the other ſweep the arch 8 at pleaſure. In this manner proceed with all the other diviſions on the vaſe, until its whole curvature is laid down on the perpendicular line at No. 1.

After proceeding thus far, it muſt then be conſidered how many pieces of veneer will cover the circumference of the vaſe, and how broad the veneers may be laid; which in this example I have ſuppoſed to be fourteen. Divide therefore each ſemicircle

into

into ſeven, as ſpecified by the ſmall dots on each arch. Upon the ſemicircle 9 of the vaſe, place one foot of the compaſſes on 9, and extend the other to the perpendicular line, which will be half the breadth of the veneer, according to the number of pieces propoſed. Take this opening of the compaſſes and place it each way from the perpendicular line at No. 1 on the arch 9. Again, on the ſemicircle 8, take the ſpace from the perpendicular line to 8, and transfer this to the arch 8 at No. 1, placing it each way from the perpendicular as before. In this manner proceed with the reſt, by which the proper breadth of the veneer on each ſemicircle will be determined; and if a regular curve line be drawn through each point on the ſeveral arches at No. 1, the curved boundaries of theſe arches will be the exact ſhape of the veneers, which, when properly laid down, will then have the appearance of ſo many ſtraight joints. And hence, by whatever rule or method we find the coverings of ſolids, regular or irregular, by the ſame rule we alſo find curved lines to anſwer their perpendicular ſections; for it is evident, if the vaſe, after being veneered, was cut through its center perpendicularly, and the veneer raiſed up again, that its edge would be a faint curve, like that at No. 1.

PROB.

PROB. XXX. FIG. 33. Plate VI.

To find the covering and perpendicular Section of a Solid partly convex and partly concave.

Operation.—Draw the profile of the solid propofed, as Fig. 33. Let fall a perpendicular from the center of the top. Draw a line from 11 on the profile parallel with the top, and divide the aforefaid perpendicular line into any number of equal parts, which in this example is ten. Draw parallel lines through each of thofe divifions, and on thefe lines draw fo many femicircles, whofe diameters fhall be equal to the length of each line. Draw a perpendicular at pleafure, as at No. 1. Fix one foot of the compaffes at 1 on the profile, and extend the other to 2. With this opening fix one foot at 1, No. 1, and fweep the arch 2. From 2 on the profile, extend the compaffes to 3, and transfer this from 2 to 3 at No. 1. Then opening the compaffes, fix one foot at 1, and fweep the arch 3 at No. 1, and fo on of all the other; by which the dimenfions of the curvature of the profile will be obtained.

Laftly, take half the whole fpace from 11 on the femicircle to the perpendicular line fpecified by the dot, and place this opening of the compaffes each way from the perpendicular line on the arch 11 at No. 1, and mark the places with a pencil.

Proceed

Proceed to 10 on the ſemicircle 10, and take half of its whole ſpace, and place it each way from the perpendicular on the arch 10 at No. 1, as was done on the arch 11 before; and in this manner go through the whole, and a ſufficient number of points will be found in order to draw an irregular curve anſwerable to a perpendicular ſection of the propoſed ſolid, and which will alſo anſwer for its covering or veneering.

• But here I muſt obſerve to the workman, that in caſe it ſhould be propoſed to him to veneer any thing of the like forms of Fig. 32 and 33, it would not do to cut out the veneers ſo broad that fourteen pieces would be equal to the circumference. It would require twenty-eight pieces at leaſt, before they could be laid down with ſafety and eaſe, eſpecially if it were required that the joints of the veneers ſhould be ſo cloſe as to preclude the neceſſity of putting in ſtringing to hide them. I ſpeak this not merely from theory, but practice, having myſelf veneered knife-caſes of the ſame ſhape with the figures in the Plate, and where no ſtringing was admiſſible to hide the joints. But every thinking workman will eaſily perceive that it makes no difference in the methods of finding the curve lines for the covering, whether the number of pieces be fourteen or twenty-eight.

By theſe methods a ſphere or globe may be covered, and a

curve,

curve, anſwerable to any ſection, through its center may be found. I have not given any example of this on the Plate, as it is preſumed that a few hints will ſerve, after what has already been ſaid on the ſubject.

Operation.—Draw a circle whoſe diameter ſhall be equal to the axis of the ſphere to be covered. Divide the ſemi-diameter into nine equal parts, and on theſe parts draw lines acroſs at right angles with the diameter, till they touch the circumference of the circle on each ſide. From theſe ſeveral lines draw ſemicircles, as was done before in Fig. 32 and 33. Divide the ſeveral ſemicircles into eighteen degrees each, and take one degree from the largeſt ſemicircle, and place this opening of the compaſſes on a right line eighteen times. Then from the extreme points on this line draw arches each way, till they meet in the center of the line. Laſtly, transfer half a degree from each ſemicircle to their correſpondent arch, laid on each way from the right line, as was done on No. 1, Fig. 32; and the whole thus transferred, a curve line paſſing through each half degree laid on the ſeveral arches both right and left from the center line, will form the proper covering for the ſphere or globe as required.

Obſerve, the covering will be of the figure of two ſegments of a circle joined together, and the length of the cover-

ing will be equal to half the circumference of the propofed fphere.

I muft here entreat leave to remark, that notwithftanding the above directions are addreffed to men in the wooden way, yet it is certain that the Upholfterer may avail himfelf from what has been faid on the fubject: for the coverings of the like folids made of any kind of ftuff, ought to be cut by the fame methods, and fewed together in feams anfwerable to the joints in wood: but the elafticity or pliablenefs of ftuffs, &c. makes it unneceffary to cut them into fuch fmall pieces as is abfolutely required in wood.

PROB. XXXI. FIG. 34. Plate VI.

To find the Section and Covering of a Knife-cafe whofe front is a double oge.

Draw half the plan of the front, as Fig. 34, and divide the fweep of the front into ten equal parts, as the figure fhews. Next determine how much rake the knife-cafe is to have from back to front, by which it will be eafily feen how much the fwell of the front falls at that rate, as the diagonal line 10.1 fhews in the cafe before us. Draw from 10 of the diagonal line a perpendicular at pleafure. From the feveral

divifions

divifions on the curve of the front draw parallel lines, till they cut at the numbers on the aforefaid perpendicular. Obferve, that the numbers on the perpendicular line are placed to anfwer the parallel lines as they proceed from each number marked on the curve of the front. Every thing being now prepared for finding the covering and fection of the knife-cafe, proceed to No. 1, and draw a right line at pleafure, as 1.11. Take from 11 to 10, or any other of the divifions, on the front of the knife-cafe, and with the compaffes repeat it nine times on the right line 1.11 at No. 1. Then obferve, that from 2 to 1 on the front of the knife-cafe is rather a wider fpace than the other divifions, which are all equal. The intention of this is, to bring the parallel line, which proceeds from 2 on the front, a little farther on from the front line 1.1; therefore take from 2 to 1 on the front, and place it from 2 to 1 on the right line at No. 1, then will the whole length from 1 to 11 at No. 1 be equal to the whole curvature of the front of the knife-cafe, fuppofed to be ftretched out in a right line. On the feveral divifions on the right line 1.11, at No. 1, draw perpendicular lines at pleafure. Take in the compafs the fpace 1.1 from Fig. 34, and transfer this opening to the perpendicular line 1 *c* at No. 1, marking it with a pencil. Then again take the fpace from 2 to the diagonal line at Fig. 34, and transfer this to the perpendicular line 2 at No. 1, and mark it with a pencil as before. Do the fame from the lines 3, 4, 5, 6, 7, at Fig. 34, and

 obferve

obſerve that 11 follows 7, becauſe it proceeds from the point 11 on the front of the caſe; therefore take the ſpace from 11 on the perpendicular line to where the parallel cuts the diagonal, and place it on the perpendicular at No. 1. Likewiſe take 8 and 10 in the ſame manner. As for 9, it is loſt, becauſe that diviſion on the front of the knife-caſe falls on the right line, and, of courſe, has no projection. Laſtly, through all the points on each perpendicular at No. 1, draw a curve line, which will anſwer to the ſection of the knife-caſe, if it be cut anſwerable to the bevel line 10.1 on the plan of the caſe.

The dark ſhade *e a b*, at No. 1, ſhews half the veneer or covering of the knife-caſe; and if a piece of ſtrong paper be cut double, according to the boundaries of the dark ſhade, it will ſerve as a pattern to cut the knife-caſe open by, and likewiſe to cut the veneer by, before it is glued down. The inſide veneer for the front of the top may alſo be cut near enough by it, though it will vary a little; but this defect is not equal to the advantage of having the inſide veneer pretty nearly cut to the ſweep, becauſe it will then glue down much eaſier, and be leſs liable to ſplit.

From what has been ſaid on this Problem, the ingenious workman may apply the rules and obſervations to other purpoſes that may be of more importance than the cutting and

veneering

veneering of a knife-cafe, which I muft leave him to do as neceffity may require.

Of the Nature and Conftruction of Hip and Elliptic Domes for Beds.

Domes of various kinds have, for many ages paft, been introduced into elegant and magnificent buildings, on account of their graceful effect and majeftic appearance.

I am of opinion that the notion of employing domes for the roofs of grand buildings, was firft fuggefted by the appearance of the hemifphere furrounding our earth or horizon, forming a canopy or roof to the globe; which if it were fo, domes had their origin from a truly fublime and magnificent idea.

The ufe of domes for the tops of beds is of much later date than for buildings; but it is certain, whoever he was, that firft employed domes for the tops of beds, he muft be confidered as a perfon of enlarged ideas, as no other top or roof for a genteel bed can equal them: therefore we fee them generally ufed for ftate beds, where, it is certain, both grandeur and bold effect are effentially requifite.

The

The term Dome generally implies a vaulted, arched, or ſpherical roof. Some derive it from *domus*, a houſe, and others from the barbarous Latin *doma*, a roof or open porch.

When an arched roof is raiſed from a ſquare or oblong plan, it is called an Hip Dome, becauſe they require mitre ribs at each angle, uniting in a center at top. But thoſe domes which take their riſe from an oval plan are called Elliptic; and, laſtly, thoſe which have an octagon or hexagon for their plan may be ſtyled Polygonal Domes.

PROB. XXXII. FIG. 35. Plate VII.

To conſtruct an Hip Dome.

Operation.—Let A B C D be the under teſter, upon which another teſter is to be fixed to receive the ribs of the dome. Draw the diagonals D B and A C, and their interſection will be the center for the dome. Draw a right line through the center parallel to A B; draw another line through the center at right angles with it, then will the diagonal lines be the plans of the hip ribs, and thoſe at right angles to each other will be the plans for the center ribs. Draw a circle from the center of the dome of about eight inches radius, as the figure ſhews, which is intended as a ground for ornament in the center of

the

the dome at the infide, and alfo to combine together the hip and center ribs.

Proceed next to confider the height of the dome as may be required. Let 7.6 at No. 1 be the perpendicular height of it, and let *m n* be the width of the dome. Then draw a femi-ellipfis to pafs through the points *m* 6 *n*. Divide half of this femi-ellipfis into as many equal parts as it may be thought neceffary to have ribs in that fpace, which in this example is fix. Draw on thefe divifions perpendicular lines, as the figure fhews, and fubdivide the laft fpace, from which raife a perpendicular as before..

Proceed to No. 2, and divide half the length of the dome, as *f o*, into the fame number of equal parts as half the width was divided into. From the divifions raife perpendiculars at pleafure. Take the length of the feveral perpendiculars from No. 1, and place them on the correfponding perpendiculars at No. 2, and draw a curve line through each point; then will the ellipfis thus produced be the outfide fhape of all the long ribs, the fame as No. 1 is of the fhort ribs. Laftly, proceed to No. 3, which is for the four hip ribs. Draw the dotted lines from 8, 9, 10, 11, 12 at No. 1 till they cut the diagonal line *g h* at the correfponding numbers. From thefe interfections raife perpendiculars at pleafure, as before. Transfer the length of each

 perpen-

perpendicular line from either No. 1 or 2 to No. 3 on each perpendicular as numbered, and drawing a curve line through each point as before, it will produce an ellipsis for the outside shape of each hip rib.

The next thing to be considered, is the length required for each rib, according to their distance from each angle of the dome. A little thought will make this easily understood; for if No. 3 was placed in an upright position, being considered as a frame, and if the portion of the curve from *n* to 1 at No. 1 was placed upright to it, the two points 1 in No. 1, and 1 in No. 3, would coincide, and the point 2 of No. 1 would coincide with 2 at No. 3; and so of all the rest. Hence, from *n* to 1 of No. 1 is the length of the first short rib, whose plan is at *a*; from *n* to 2 is the second short rib, whose plan is at *b*; from *n* to 3 is the third short rib; its plan at *c*: from *n* to 4 is the fourth short rib; its plan at *d*: and from *n* to 5 is the fifth short rib; its plan at *e*. The long ribs are taken from No. 2 in the same manner; each of which has its plan laid down at No. 3, as *a b c d e f*, so that I need not say any thing more on this part of the subject. For the length of the hip ribs, take from *p* to 5 at No. 3, and allow three-quarters of an inch for dovetailing into the center block.

General

General Obſervations on the Management of Hip Domes for State Beds.

Theſe kinds of domes ſhould be made in four parts, for the ſake of convenience in fixing up, or for more eaſy conveyance into the country. The center block ſhould therefore be made in four quarter parts, on account of the hip and center ribs which are fixed into it, that the four quarters of the dome may eaſily be ſeparated and put together again without injury. Domes in four parts muſt therefore have eight hip ribs, or two at each angle, mitring together, to which the ribs of each ſeparate quarter are fixed. For the footing of theſe ribs a ſham or upper teſter ſhould be formed, about three inches in breadth, which will give room beyond the ribs to ſcrew it to the under teſter.

When the four quarters of the dome are thus formed by ribs, a covering of thin deal, like Venetian ſhade ſtuff, ſhould be provided, and after covering both inſide and outſide of the dome, the deal may be ſized over with thin glue, to ſtrengthen it. After the ſize is dried, then good canvas may be glued or paſted on, both inſide and outſide of the dome, which will add to its ſtrength, and give ſmoothneſs to its ſurface. The outſide of the dome may then be painted, to match the furniture of the

bed, and the infide is always lined with whatever kind of ftuff the hangings are made of.

The infide of the dome fhould have neat gilt mouldings up the hips, both for ornament, and to hide the joint which is occafioned by the mitring of the quarters together. And from the fpring of the dome, or round the under tefter, fhould be an ornamented architrave, which will receive and hide the lower end of the hip-mouldings, and will alfo cover the tacking of the inner valence, as well as contribute to the grandeur of the effect of the whole. To thefe ornaments fhould be added a richly carved patera, fixed to the center block of the infide of the dome, which will alfo receive and hide the upper ends of the hip-mouldings before mentioned. Laftly, a ftuffed head-board, in a gold frame, with foliage ornaments on the top of it, in imitation of a pediment, will add greatly to the effect of the whole, and harmonize with the other enrichments abfolutely neceffary for a ftate bed.

For the outfide ornaments of a bed of this kind, great care fhould be taken to avoid every thing that would appear trifling. The pillars fhould be maffy as well as tall, fuited to fupport the dome, whilft height gives room and effect to fine drapery. Sometimes the pillars are white and gold, and fometimes all gold; or the ground of the ornaments may be of the colour of the filk, &c. of which the hangings are made. If emble-

matical ornaments are introduced in the cornice, or on the top of the dome, thoſe deſcriptive of unity, love, and innocency, ſhould be ſtudied; and thoſe of war, ſtrife, or other irregularities of the human paſſions, ſhould be avoided.

Noblemen's creſts may be introduced, as ſerving to diſtinguiſh the different branches of families; but, in my opinion, not as they relate to armory.

The height of a ſtate bed may be varied according to the different heights of rooms they are to ſtand in. However, they never ſhould be leſs than twelve feet to the top of the dome, including a vaſe. Nor ſhould they, in my opinion, exceed fifteen feet, not even where a room would admit of it. For then the ornaments of the cornice and dome would loſe their effect through diſtance, and the whole compoſition would appear as if loftineſs were the greateſt beauty.

The length of a ſtate bed may be ſeven, but ſometimes eight feet, when the area of a room is extenſive.

The width of theſe beds is in general about one foot ſhort of their length, but ſometimes they are made nearly ſquare.

The height of the frame, including the caſtors, is fourteen inches.

French caſtors are the beſt for the purpoſe, fixed upon a ſtrong iron plate, ſcrewed to the under edge of the ſides and ends, ſo that the caſtors may run clear of the pillars, and be detached from them, by which their riſe is hid from the eye.

Theſe are remarks made from my own experience in the buſineſs, which I offer for the aſſiſtance of the candid workmen of both branches; but the ſnarling critic may reject them if he pleaſe.

PROB. XXXIII. FIG. 36. Plate VII.

To conſtruct an Elliptical Dome.

Operation.—Let A B, D E be the plan of the teſter, whoſe inſide forms a true ellipſis by the help of angle pieces framed in, which muſt be evident to every workman.

The oval being thus formed according to the inſide length and breadth of the teſter, and the two diameters being already drawn, proceed with one quarter of the dome thus: draw the plan of the upper teſter, into which the ribs are to be fixed, as the ſecond elliptic line ſhows. Divide then the portion of the

ellipfis between *o* and *l* into as many equal parts as it is required to have ribs in one quarter of the dome, as at *o a b i j k l*, tending to the center *b*.

From thefe center lines draw parallel lines on each fide, which fhall determine the thicknefs of the ribs, and at the fame time fhow how broad each rib will be required, in order to give it its proper twift fo as to fuit the ellipfis; for here it muft be obferved, that every rib, excepting the one that is upon each femidiameter, muft have a winding form, both infide and outfide, in proportion to the length of the oval with its breadth.

Determine, next, how much the dome is to rife from the tefter, which, in this example, I confider to be equal to half the fhort diameter; and therefore the arch of the rib B is a quadrant of a circle, drawn from the center *b*. This arch will ferve for two ribs, that is, B and its oppofite. Likewife, from the arch B, we determine the outline of every other rib thus: divide the femidiameter *a b* into five and an half equal parts, and raife perpendiculars till they touch the arch B. Divide the plan of the rib *a b* at No. 2 into the fame number of equal parts, and raife perpendiculars at pleafure; to which perpendiculars transfer the feveral lengths of thofe at No. 1 to the corresponding ones at No. 2, as *a c d e f g*; by which the rib A will be formed. The ribs for *b i j* and *k* are formed in the

fame

fame manner, and therefore it is unneceffary to defcribe thefe.

Obferve; C, on the plan of the elliptic tefter, is for the long center rib and its oppofite, as will eafily be underftood by infpecting the figures, and a little reflection on the fubject.

Of the Management of Elliptical Domes.

Thefe domes may be made in four parts, the fame as hip domes, if required.

The ribs of thefe domes are all dovetailed into a center block, which may be circular or elliptical to fuit the dome, and which ferves for the ground of a carved and gilt patera for the infide of the dome, as has already been mentioned on hip domes.

When the ribs are all completely fixed, the fpaces between them may be filled up by glewing white deal in; and when the pieces of deal are worked down to the ribs, the whole will form an agreeable dome, which fhould be covered with canvafs, and painted to fuit the furniture, or otherwife covered with the fame kind of ftuff. And if fo, it will be unneceffary to cover it with canvafs; but as the ftuff muft be put on the dome in fo many

many breadths, cut ſo as to anſwer its ſhape, a gimp may be ſtitched on to hide the tacks and give the dome a more rich appearance. But if the dome be large, it may have ſmall gilt moulding in place of the gimp, which are fixed to the dome by gilt-headed ſcrews.

For the inſide of the dome, it will be requiſite to nave a gilt moulding, to hide the joining of the under and upper teſter, and to ſerve as an architrave to the dome.

The triangular compartments at each corner of the teſter, occaſioned by the manner of framing it to ſuit the dome, ſhould have ſmall mouldings put on to ſuit that ſhape, which will take off the flat and heavy appearance it would otherwiſe have, and add to the effect of the whole. As for any other particular with reſpect to ornaments, what has already been obſerved on hip-domes may alſo be applied here.

With reſpect to the dome deſcribed by Fig. 37, I do not think it neceſſary to go through an explanation of it after what has been ſaid on Fig. 35, which, if the reader has fully underſtood, he cannot fail to be acquainted with the lines laid down in Fig. 37, merely from inſpection, eſpecially as I have marked each correſponding line with ſimilar letters and numbers.

SECTION VII.

Of the Proportion of the five Orders, adjusted by Modules, Minutes, and aliquot Parts; together with some Account of their Antiquity and Origin. Also of the general Proportions of Frontispieces adapted to each Order.

INTRODUCTION.

I HAVE no doubt but it may be thought unnecessary by some to introduce the orders of architecture into this work, after so many publications of this sort by men of the first class in the profession of this art.

To remove this objection and unfavourable impression from the mind, I shall just mention two or three particulars which induced me to make the five orders a part of this Drawing-Book.

First.—In my opinion, and it is presumed that I am not singular in this, nothing can appear more worthy of a place in a complete drawing-book than the five orders accurately laid down and neatly engraved; by which we see the proportions and effect of each moulding arranged and connected

nected together, according to the compofitions of thofe ancient architects of Greece and Rome, who are fo juftly famous in the world.

Befides; from a Plate of the above kind, we are not only made acquainted with the proportions and fhape of each moulding, but have likewife the advantage of feeing the effect of light and fhadow produced by the fun's rays falling in a certain direction on the feveral parts of a column.

The knowledge of thefe particulars muft ever be confidered as effential parts of good drawing, in which architecture is often introduced, and fometimes makes the principal figure.

Second.—As many cabinet-makers, and even fome ingenious upholfterers, are found defirous of having a knowledge of the five orders, and the proportions of the feveral frontifpieces, I thought an attempt of this fort would be favourably received, as it undoubtedly tends to make the work more generally ufeful, and will prevent the trouble and expence of having recourfe to other books on the fubject. And this has not been merely my own opinion, but the fentiment of fome well-wifhers, who defired me to let the orders have a place in my book.

Laſtly.—Beſides the reaſons juſt mentioned for publiſhing the five orders, I muſt frankly own myſelf a lover and admirer of thoſe ancient productions of ingenuity and art, which, in my opinion, cannot be much, if in the leaſt, improved by the force of modern genius.

If, therefore, the author conſiders himſelf as a kind of devotee or bigot to theſe remaining monuments of ancient ingenuity, ſurely he may be granted the liberty of paying the following ſmall tribute to the memory of thoſe great architects who had the honour of bringing the five orders to that perfection which we now ſee them in at this day.

And further, as I believe that the orders are now brought to ſuch perfection in their proportions, as will bear the ſtricteſt mathematical examination, I conſider them as incapable of improvement, except perhaps in ſome part of their ornament, and therefore they are claſſed with thoſe things in this book that will remain unalterable.

Of the Origin and Antiquity of the Order of Architecture.

Some diſtinction is to be regarded between the origin and antiquity of the orders, and that of architecture * in general.

The firſt ideas of architecture in general, may perhaps be traced from thoſe rude and irregular methods of building tents and huts which were the firſt habitations of man.

But in theſe ſtructures, nature and neceſſity were their only guides, unleſs they obtained ſome inſtructions or hints from the manner in which birds build their neſts, as Vitruvius conjectures.

We are informed by Moſes, that Jabal was the father of ſuch as dwelt in tents: and I ſuppoſe it is meant, that he was the firſt maker of them likewiſe. And I further imagine, that the city which Enoch built about that time was an aſſemblage of thoſe tents, perhaps ſurrounded by a mud wall, and ſo ob-

* Architecture implies the ſcience of building in general, which gives rules for deſigning and raiſing all kinds of ſtructures or edifices. It is from the word architect, compounded of αρχος, archos, the principle, and τεκτων, tecton, the chief artificer, or one who gives rules for, and directs the management of, buildings.

tained the name of a city in thofe days; for it can fcarcely be thought that they had at that time either difcovered ftone, or knew how to make brick, and much lefs how to put them together in houfes, fo as to form a city according to thofe mentioned in after times.

But, however, very early after the flood of Noah, we read of an attempt made to build a city and tower whofe top was to reach the heavens. Their materials were then brick, and flime for mortar. And when we confider how great their defign was, and how fuccefsfully they proceeded until the Divine Hand ftopt them, we muft neceffarily infer, that men in thefe days began to know the rules of building, and of courfe this may be confidered the origin of regular architecture.

But the origin of that part of architecture called the *five Orders*, is of much later date than this. They appear to me, and it has been the opinion of fome great architects, that they owe their beginning to Solomon's Temple.

I do not mean that pillars or columns were never in ufe before this famous building was erected, but only that we do not read of certain proportions affigned to their height and diameter till thofe given to Jachin and Boaz, the names of two pillars fet up at the entrance of the porch of this building.

We

We read of pillars above four hundred years before the days of Solomon: and we read alſo, that theſe pillars had chapiters and fillets of gold and ſilver; but no mention is made of their height* or diameter; yet ſomething may be known as to the intercolumniation of theſe pillars, for there were twenty pillars ſtanding in an hundred cubits, the length of each ſide of the tabernacle. See Exod. xxxvi. 38. and xxxviii. 11. However, as there are no proportions aſſigned to theſe pillars, I preſume we cannot date the origin of the orders here; yet I think there would be more plauſibility in it than what ſome have advanced on this ſubject.

The pillars which Solomon erected at the entrance of the temple were of the following proportion, according to the language of the ſcriptures:—Their height was eighteen cubits, or twenty-ſeven feet without their chapiters or capitals; and their chapiters were five cubits; which in all makes thirty-four and an half feet in height. A line of twelve cubits did compaſs either of them about, conſequently their diameter was ſix feet; and had theſe pillars been one cubit higher, their proportion would have anſwered exactly to the original Doric † Order, whoſe height was equal to ſix of its diameters.

Beſides

* Joſephus indeed ſays, "Every pillar was five cubits in height;" and he ſpeaks alſo of five pillars at the entrance of the tabernacle, that were gilded, and ſtood on baſes of braſs.

† For ſome time after the firſt invention of this order, the proportion of its diameter to the

Besides the likeness or affinity between the Doric column and those set up by Solomon, will still appear more striking, if we consider that the ancient Doric had no plinth or base; for does not appear to have been any at the foot of Jachin and Boaz, otherwise I think they would have been mentioned as well as the chapiters. But these columns are said to have fillets, whose thickness was four fingers, and they were made hollow. See Jer. lii. 21.

These fillets seem to answer well enough to the Doric necking at the top of the shaft. They were hollow, and of four fingers thickness or projection, which is nearly the same projection as would be required in the necking of a Doric column of the dimension of Jachin and Boaz.

There is another particular which may be mentioned which also bears some likeness to the Doric, and that is the size of the porch or entrance, on each side of which these massy pillars were placed.

This opening was twenty cubits in width, and forty in height, answering to the proportion of the Doric frontispiece or door.

the height was as the length of a man's foot is to the height of his whole body, which at that time was reckoned to be one sixth part; but afterwards they added another diameter, and at length brought it to eight.

And laftly.—The lily-work on the chapiters, and the rows of pomegranates round about the chapiters, were, in my opinion, as likely to have given rife to the ancient Doric order, and more fo than the manner of building ancient huts, by placing trunks of trees on each fide, by which the roof was fupported.

Yet I will not fay but trunks of trees thus employed, might firft give exiftence to the notion of fome kind of a pillar to be ufed in the firft buildings of brick or ftone, while, at the fame time, I am inclined to think that columns were never reduced to any order till the building of Solomon's temple by God's appointment.

However, it is not to be underftood as if the regular Doric order could be copied from Solomon's pillars, but only fuch hints and proportions taken from them as ferved in after times to compofe the firft order of architecture.

Nor can it be thought that the firft compofition of the Doric column had thefe triglyphs and mutules which we now fee it has, till after it was reduced to its proper form and character. It is therefore thought to have been more fimple and maffy in its primitive ftate; fomething like the Tufcan order. Some imagine,

imagine, and not without ground, that the Tuſcan, nearly as we have it now, was the firſt ſtate of the Doric.

Vitruvius ſpeaks of a ſtate in which the Doric column was in before it was reduced to order; for, treating of the antiquity of the Doric, that it was uſed in the temple of Juno, at Argos, he ſays, that "the ſame order was alſo uſed in the other cities of Achaia, before the laws of its ſymmetry were eſtabliſhed."

This indicates that it was in a more rude ſtate before it was employed in that famous temple.

But if that temple, dedicated to Juno, was erected in the days of Dorus, the king of Argos, as Vitruvius intimates, it would be rather incredible to think that the Doric order ſhould be in exiſtence in times ſo long before Solomon*: and, upon ſuch a ſuppoſition, thoſe who maintain that the firſt idea of the orders was derived from Solomon's temple, would be groſsly miſtaken.

A certain author, after quoting Vitruvius on the ſubject, ſays, "Such is the account given by Vitruvius of the origin of

* Dorus muſt have been, at leaſt, four hundred years before Solomon, if he reigned at Argos before the expedition of the Argonauts.

improvements in the proportion of columns. Had improvements, however, exiſted in ſuch early times, Homer *, who was greatly poſterior to them, would certainly have made mention of ſomething of the kind; but in all his writings he gives us no account of any thing like columns of ſtone, but uſes a word which would rather incline us to think that his columns were nothing more than bare poſts."

This account looks as if there had been neither ſtone columns nor temples till after Homer's days. For if the architecture among the Greeks in thoſe days conſiſted of bare poſts, we cannot ſuppoſe that thoſe magnificent temples which they dedicated to their gods were ſo poor and plain; neither can we imagine that if there had been ſuch fine temples in his time, that he would have left them unnoticed. It would ſeem as if the Greeks had borrowed their firſt notions of temples to worſhip their gods in, and alſo their architecture to adorn them with, from that at Jeruſalem.

Agreeable to this view, the above quoted author ſays: "It is remarkable that improvements in architecture did not take place in any nation till after, or about, the time that Jeruſalem was taken by Nebuchadnezzar. The grandeſt buildings amongſt the Aſſyrians ſeem to have owed their exiſtence to this mo-

* Homer was born above nine hundred years before the Chriſtian æra.

narch; and it can ſcarcely be imagined that he would not endeavour to imitate the architecture of Solomon's temple, to which, by his conqueſt of Jeruſalem, he had full acceſs *."

Upon the whole then, I think it will agree better to the above facts, if we affirm that the Doric order had its name and improvements from the Dorians, who occupied the country of Doris, a Grecian diſtrict, of which Dorus had formerly been king.

The Ionic order ſucceeded the Doric, according to antiquity, and was an improvement from it. It had its name from Ion, the Grecian country or diſtrict where it was invented, and firſt employed in the temple of Diana at Epheſus. By the accounts we have of this temple, architecture muſt have arrived to a conſiderable degree of perfection in theſe times. This temple at Epheſus, the metropolis of Ion, was about four hundred and forty feet long, and two hundred and thirty feet wide; was ſupported by one hundred and twenty-ſeven pillars of the above order, and about ſixty-two feet high. It was built in marble, and decorated with the fineſt ornaments; and, as the hiſtory ſays, exhibited the moſt perfect model of this order.

* According to Prideaux, Nebuchadnezzar took Jeruſalem ſix hundred and five years before Chriſt.

The Corinthian comes next in order, which has its name from Corinth, a city or chief town in Achaia, a Grecian diftrict or territory. In this city the Corinthian order had its origin. The account which Vitruvius * gives of it is fomewhat curious and entertaining; I fhall therefore tranfcribe it.

" The third," fays he, " which is called Corinthian, is in imitation of the delicacy of virgins; for the limbs are formed more flender, and are more graceful in attire. The capital is reported to have been thus invented:—a Corinthian maid, being feized with a diforder, died; after her interment, her nurfe collected, and difpofed in a bafket, the toys which pleafed her when alive, carried it to the tomb, placed it on the top, and, that it might endure the longer in the open air, covered it with a tile. The bafket chanced to be placed over the root of an acanthus, which being thus depreffed in the middle, the leaves and ftalks in the fpring feafon iffued outward, and grew round the fides of the bafket; and being preffed by the weight at the angles of the tile, were made to convolve at the extremities, like volutes. At that time Callimachus, who, for his ingenuity and excellence in the arts, was by the Athenians named Catatechnos †, happening to pafs by this tomb, took notice of the bafket, and being pleafed

* Vitruvius was an ancient Roman architect, who wrote a fyftem of architecture, it is thought, in the time of Titus, the eleventh Roman emperor, who reigned in the year 79, to whom he dedicates the work.

† The firft of artifts.

with the delicacy of the foliage growing around it, as well as the novelty of the form, made ſome columns near Corinth according to this model, and from thence eſtabliſhed the ſymmetry, and determined the proportions, of the Corinthian order."

The Tuſcan order is the fourth in point of antiquity, but in the arrangement of the five orders it is put firſt, on account of its ſimplicity and plainneſs. It had its origin in Tuſcany, a place remarkable in Italy, which was firſt inhabited by the ancient Lydians out of Aſia. Theſe people firſt built temples of this order, and dedicated them to their gods in their new plantations. Vitruvius calls it the ruſtic order, which is conſiſtent enough with what I formerly conjectured, namely, that this order was the firſt ſtate of the Doric column in its moſt antique form. And the circumſtance of its being brought from Aſia by the ancient Lydians, helps to confirm it.

The Compoſite is the laſt. Its name denotes that it was compoſed from the other regular orders.

It is alſo called the Roman order, becauſe it was reduced to its proportional ſtandard in that country.

It does not appear to be ſo ancient as the days of Vitruvius, as he makes no mention of it. He ſpeaks of various capitals that might be introduced on the Corinthian column, but does not name them. "There are," ſays he, "alſo other kinds of capitals, called by various names, which are diſpoſed on the ſame columns, and which have no proper ſymmetry or relation to any order of columns that can be named differently; but they are all derived and transferred from the Corinthian *."

Theſe words, and the liberty they convey in favour of the compoſition of varieties of capitals to the Corinthian column, it may be preſumed, gave riſe to the compoſition of this order, which, in any other reſpect but the capital, is nearly the ſame with the Corinthian. Some architects, however, do not incline to ſpeak well of it, becauſe it appears to have been picked and culled from all the other orders, and is ſometimes badly arranged, on account of the liberty both taken and granted in this ſpecies of architecture. However, in my opinion, it forms a very beautiful appearance when rightly managed.

The original inventor of the compoſite order is thought to have been one Serlio.

Having now ſaid as much on the antiquity and origin of the five orders, as is neceſſary to give a workman a proper view

* See Newton's Tranſlation of Vitruvius.

of

of the ſubject, I ſhall now proceed to deſcribe the proportions and character of each diſtinct order, and likewiſe explain the names of each moulding.

*Of the Tuſcan Order.** See Plate VIII.

The Tuſcan order is the moſt ſimple of any of the orders. It is alſo diſtinguiſhable from the other, on account of its ſtrong and maſſive appearance. On which account, in the figurative ſtyle, it has obtained the name of the ruſtic order; and in conformity to this character it is generally employed in farm-houſes, ſtables, and other buildings in the like ſituations. It is, however, ſometimes uſed in grander buildings, where ornaments are not required, but where ſtrength is the principal object.

The proportion of the Tuſcan column, with its pedeſtal and entablature, is as follows:

Divide the whole height, for the complete column, into five, as the figure ſhows. Take one of theſe parts for the pedeſtal as at 1, whence the line is directed that determines the height of the pedeſtal. From this line divide the whole height again into five equal parts, as the ſecond upright ſcale ſhows.

Take one of theſe parts for the whole entablature, and the remaining four is the height of the column, including its baſe and capital. Divide the height aſſigned for the column into ſeven equal parts, as is ſhown on the third upright ſcale. Take one of thoſe ſeven parts for the inferior or lower diameter of the column, not including the projections of the baſe, but ſimply confined to what is commonly called the ſhaft, or cylindrical part of the column. Take half of the inferior diameter, and give it for the height of the baſe, and alſo for the height of the capital, not including the aſtragal at the neck. Proceed next to draw a module, by which to determine the ſmaller parts of the column with the heights and projections of its members, as ſpecified by the upright and horizontal numbers oppoſite to each member on the large ſcale.

Draw a right line at pleaſure. Lay, on this line, a ſpace equal to one diameter. Divide it into ſix equal parts, and draw perpendiculars from each diviſion indefinitely. Lay on five equal diviſions on any of the perpendicular lines, and draw parallels through each.

Draw then two oblique lines, meeting in a point at half of the firſt diviſion 10, which ſpace will then be divided into ten, at the numbers 1, 2, 3, 4, 5, &c. ſo that any number of minutes up to ſixty may be accurately taken from this ſcale.

I have alſo ſhown a module at the bottom of the larger pedeſtal, which is equal to two of the ſmall modules, from which all the minutes are taken and placed as beforementioned, as the Plate of itſelf will make ſufficiently clear by inſpection.

A module is conſidered by ſome as only half a diameter, but others extend it to a whole diameter; which laſt I have adopted, as being the moſt ſimple and entire, and therefore more eaſily remembered by workmen.

Vitruvius uſes the large module, reckoning the proportions of the column by the thickneſs of the lower diameter of its ſhaft. And I do not ſee but it anſwers as nearly to the different parts of a column as the ſemidiameter does, or as that of twenty minutes, which has been contrived by ſome.

The projection of each member is alſo denoted by aliquot, or equal parts; and each part is equal to a minute taken from the ſcale; ſo that if the reader ſhould find any little inaccuracies in the aliquot parts, which it is almoſt impoſſible to avoid in ſuch ſmall ſcales, he may correct theſe by the numbers. And obſerve, that the cornice of the pedeſtal projects 11½ minutes, which is the whole ſum of the projection of each member, denoted by 2, 4, 3, 2½, and which amount to 11½. The baſe of the pedeſtal projects the ſame. Its fillet is two parts; the ogee, or cyma-recta, ſeven and an half; and the ſquare two; which is in all eleven and an half. The baſe of the column projects ten; the

The conge, or apophyge, four; and the torus ſix. The upper conge of the neck of the capital three, and its aſtragal one and an half. The capital, in all, projects twelve minutes; the firſt fillet two, the ovalo ſeven, the abacuo one before it, and the upper fillet two. The whole projection of the architrave is five, the upper facia one and an half, and its fillet projects three and an half. The whole cornice projects forty-five minutes, and its height is equal to its projection.

Of the Diminution of Columns.

Some diminiſh columns by a right line drawn from the inferior to the ſuperior diameter; but this is very jejune and inſipid, becauſe when columns are finiſhed ſtrictly in this mode, they appear too ſlender in the middle, and loſe that graceful effect which an eaſy curve line produces.

It appears that ſome of the ancients diminiſhed the ſhafts of their columns by a curve line one third from the baſe, as in Plate VIII. whilſt others of them carried this point to an extreme, by drawing a regular curve line from the inferior to the ſuperior diameter, producing a diameter in the middle of the ſhaft larger than that at the bottom. This notion has been

charged upon Vitruvius, becaufe he fpeaks of " an augmentation that fhould be made in the middle of columns;" but Mr. Newton, in a note in his book of Vitruvius, has cleared him of this charge. See page 53. And Sir William Chambers takes notice of an author who fuppofes the " addition mentioned by Vitruvius to fignify nothing but the increafe towards the middle of the column, occafioned by changing the ftraight line which at firft * was in ufe, for a curve."

" This fuppofition," fays Sir William, " is extremely juft, and founded on what is obferved in the works of antiquity; where there is no inftance of columns thicker in the middle than at the bottom, though all have the fwelling hinted at by Vitruvius, all of them being terminated by curves."

The method that this gentleman recommends as moft proper for diminifhing columns, is by an inftrument which Nicomedes invented to defcribe the firft conchoid; for this, being applied at the bottom of the fhaft, performs at one fweep both the fwelling and the diminution; giving fuch a graceful form to the column, that it is univerfally allowed to be the moft perfect practice hitherto difcovered.

* This means, before the orders of architecture had received much improvement.

This

This method has been adopted in the diminution of the Ionic, Compoſite, and Corinthian columns in Plate X, XI, and XII; becauſe theſe are the moſt delicate orders.

But, in the Tuſcan and Doric ſhafts, I have followed the common method; becauſe theſe robuſt columns will admit of more apparent, or more ſudden diminution than the other three.

The moſt common method is as follows. See Plate VIII.

Divide the ſhaft into three equal parts, and draw a diameter at the firſt part. On this diameter deſcribe a ſemicircle, and divide the ſemidiameter into five equal parts. From the fourth diviſion raiſe a perpendicular line which determines the upper diameter and cuts off a portion of the ſemicircle, which is to be divided into four on the curve. Laſtly, divide the upper two thirds of the ſhaft into four equal parts, anſwerable to the four equal parts on the curve; and from each of theſe diviſions, or parts, on the curve, draw right lines to the correſponding diviſions on the ſhaft, by which, four points will be found through which the diminiſhing curve line is to paſs, and, if accurately drawn, will appear ſmooth. Obſerve, this diminution brings the column, at its ſuperior diameter, to forty-eight minutes;

 but

but in all the other orders there are uniformly fifty minutes allowed.

Some architects, however, contend for various degrees of diminution, according to the character of each column. They assign to the Tuscan one fourth, to the Doric one fifth, to the Ionic one sixth, to the Composite and Corinthian one seventh, of the inferior or largest diameter.

This makes no difference, however, in the method of diminution above taught; for if the Tuscan be diminished one fourth, then divide a semidiameter into four parts, and take one of those for the diminution on each side, and proceed as before; so also of the other.

I shall now quote a few words from Sir William Chambers on this subject, by which the reader, if he please, may form his judgment. He says, " In the remains of antiquity, the quantity of diminution is various; but seldom less than one eighth of the inferior diameter of the column, nor more than one sixth of it. The last of these is by Vitruvius esteemed the most perfect. Vignola has employed it in four of his orders, as I have done in all of them, there being no reason for diminishing the Tuscan column more in proportion to its diameter than any of the rest."

How

How to diminiſh any Column, from the inferior to the ſuperior Diameter, by means of an Elliptic Curve not exceeding in its Swell the inferior Diameter.

FIG. 1. Plate XIII. is Vignola's method of diminiſhing a column, the principles of which I have taken from Sir William Chambers' Treatiſe on Architecture, but have here deſcribed it in my own way, as follows. Determine the height of the ſhaft as at *c d*, and draw a line for its axis. Next, draw *b a* at pleaſure, and at right angles with the axis. Let *b c* be half the inferior, and *n d* half the ſuperior diameter. Take *b c* half the under diameter, and with the compaſſes place it from *n*, the extreme point of the upper diameter, to any point where it falls on the axis of the column, as at *o*. From *n* draw a line through *o*, and proceed till it cut the baſe line *b a* at *a*. Draw a line at pleaſure from *b*, the extreme point of the inferior diameter, parallel with *c d*; and divide this line into a number of equal parts, as 2, 4, 6, 8, &c. From *a*, the center, draw a ray or right line to each of theſe diviſions, which will paſs obliquely through the axis, in proportion to their diſtance from the inferior diameter *b c*. Take then *b c*, half the diameter, and place it from 1 to 2, from 3 to 4, and ſo on of all the reſt. Laſtly, through each of theſe points draw a curve line, and the diminution

diminution of one ſide of the column will be thus completed, as is ſhewn by the dotted line on the right hand. To determine the other ſide of the ſhaft, nothing is wanted but to draw a ſquare line acroſs the ſhaft from each point, and place the diſtance 2 *x* to *x y*, and *t* 4 to *t* 9, and ſo on of the reſt.

Fig. 2. is Nicomedes' inſtrument, which, as it is here deſcribed, is intended to perform the ſame diminution as has been above explained by lines.

This inſtrument is made in the manner of a ſquare, with a ſtay to keep it firm, as at R; *b p* is a dovetail groove cut in the center of the upright piece, as T; *b a* is its baſe, in which alſo there is a dovetail groove as at *u*; *i w* is a ruler, or trammel, which moves by the dovetail-piece *y* in the groove *b p*, by which the diminution is performed; *g h* is a plain groove cut through the trammel, and *g* is a center pin which guides the trammel as *i* paſſes from *p* to *b*; when *i* is at *b*, it is evident that *h* will be at *g* the center pin, becauſe *h i* is equal *g b*; alſo *g i* is equal *o a* in Fig. 1. and found in the ſame manner. The interval, or ſpace, between the center *i* and *k* at the end of the trammel, is equal to the inferior diameter *b m*, or *b c*, Fig. 1. As, therefore, the center *i* paſſes to *b*, the center *k*, in which a pencil is fixed, cuts all the oblique lines *j j* tending to *g*, in the ſame points as at

at 2, 4, 6, 8, &c. of Fig. 1. and at the ſame time draws a perfect curve, which I take to be of the elliptic kind.

Laſtly, in order to make this inſtrument anſwer for ſhafts of various ſizes, the plain groove *g b* muſt be lengthened each way to *v* and *w* at pleaſure. The upright *p b*, and the baſe piece N *a*, muſt alſo be proportionably lengthened; and if the center pin *g* be fixed in a moveable piece to ſlide each way in the groove *u*, and fixed at any certain place by a ſcrew, as may be required, then it is evident that the inſtrument may be ſo conſtructed as to anſwer columns of any dimenſion.

Of the principal Parts of a Column, and the Names of each Member.

The principal parts of an entire order are three; the pedeſtal, ſhaft, and entablature.

The pedeſtal is the lowermoſt part of an order, comprehended between *y* and F, ſee Plate VIII. The column is the middle part of it, including the whole ſpace between the pedeſtal and top of the capital. The entablature is the uppermoſt

part

part of the whole, and contains every member between *m*, the top of the capital, and *a*.

Theſe principal parts are again ſubdivided as follows. The pedeſtal contains the plinth F, dado B, and cornice A, *z*, *y*. The column includes a baſe, ſhaft, and capital; and the entablature, an architrave, freeze, and cornice.

Thus, in every entire order there are three principal parts, and each of theſe parts are again ſubdivided into three ſmaller parts, which in all make nine; the origin of whoſe names is as follows:

F, the plinth, is from πλινθος, *plinthos*, a brick, or flat ſquare ſtone, on which columns, in their moſt antique ſtate, are ſuppoſed to have ſtood.

B, the dado or dye, ſo called becauſe it is of a cubic form.

A, *z*, *y*, the cornice, from the Latin *coronis*, a crowning; becauſe the cornice is the finiſhing, or crowning, of the pedeſtal.

x, *w*, *v*, 2,

x, *w*, *v*, the baſe of the column, from βασις, *baſis*, a foundation or footing for the column.

The ſhaft is that long and ſtraight part of a column comprehended between the baſe and capital.

Some derive it from σκαπτω, *ſkapto*, to dig, in the manner of a well, round and deep, whoſe inſide reſembles the ſhape of a pillar; and ſome from the long part of an arrow or ſhaft *.

q, *p*, *o*, *n*, *m*, the capital, from κεφαλη, *kephale*; or *caput*, the head, which the capital is to the column.

l, *k*, *i*, the architrave, ſo called becauſe it is the chief ſupport to the whole entablature, from αρχος, *archos*, chief or principal; and the Latin *trabs*, a beam.

h, the freeze, " from φιβρον, *phibron*, a border or fringe; or which the ancients uſed to call ζωφορος, *zophoros*, becauſe it was uſually enriched with the figures of animals."

From *g* to *a* is called the cornice, which is the ſame to the entire order as the pedeſtal cornice is to it. See A, *z*, *y*.

* The ſhaft of a mine is the round perpendicular paſſage they make to come at the ore.

These ſubdiviſions of the entire order have each their particular members, except the dado or freeze; and on the proper arrangement of theſe members depends much of the beauty of the whole.

The names of theſe members are as follows:

a, the fillet, from the French word *fil*, thread.

b, the cymatium, or cyma-recta, from κυματιον, *kumatiòn*, a wave; becauſe this member reſembles the ſwelling and concavity of a wave.

c, the fillet.

d, the corona, or crown; becauſe it is a principal member of the cornice, and ſerves as a ſhelter to the ſmaller members of the entablature.

The hollow part appearing at the underſide of the corona, is termed the *drip*.

e, the ovolo, or Latin *ovum*, which means an egg; becauſe this member, in the Ionic, Compoſite, and Corinthian orders, is generally carved in the ſhape of eggs and darts.

g, the

g, the cavetto, from the Latin *cavus*, hollow.

i, the fillet, liſtel, or ſquare of the architrave.

k, the upper faſcia; and *l* the lower ditto.

m, the upper fillet of the capital.

n, the abacus, from αϐαξ, *abax*, a ſhelf or table; or, as ſome ſuppoſe, a tile on which the ancient Greek mathematicians ſtrewed duſt to draw their geometrical ſchemes on.

This word ſeems to have been introduced into architecture on the invention of the Corinthian capital, which had its riſe from an acanthus growing round a baſket with a tile laid over it, as has already been deſcribed from Vitruvius. Conſequently——

o, the ovolo, which is the ſucceeding member, muſt be conſidered as the baſket over which this tile was placed.

p, the lower fillet of the capital; and *q*, the freeze of ditto.

r, the aſtragal, from ἀστραγαλος, *aſtragalos*, a bone of the heel; or the curvature of the heel, which this member reſembles.

s, the upper ſincture, which it is thought was anciently an iron hoop, or ferule, to ſecure the ends of the columns, when they were uſed without capitals or baſes.

t, the upper conge or apophyge, from ἀποφυγη, *apophuge*, eſcape; becauſe that part of the column appears to fly off.

u, the lower ditto; and *v*, the lower ſincture.

w, the torus, from τορος, *toros*, a cable, which this member reſembles.

x, the plinth of the baſe.

y, the fillet; and *z*, the corona, as before.

A, the cyma-reverſa, or the cymatium inverted.

D E, the baſe of the plinth, whoſe members are named the ſame as thoſe of the like ſhape already deſcribed.

In

In every other column fimilar members have the fame name, and therefore I fhall not repeat them over under the other columns. But as there are fome members in the fucceeding orders which differ in character and fhape from thofe that have been mentioned already, I fhall here point them out, to prevent future trouble, and to keep this part of the fubject of architecture together.

The Doric, Plate IX. for inftance, has a fcotia marked A, from σκοτια, *fkotia*, darknefs; becaufe of the ftrong fhadow which is produced by its own concavity and the projecting aftragal above it.

m, the conic drops, fo called from their figure.

k, the triglyphs, from τριγλυφος, *triglupbos*, three engravings. It is a compound of τρι, *tri*, three, and γλυφω, *glupbo*, to carve or engrave; in conformity to which derivation, the triglyph has two entire channels, and two half ones, with three fpaces between. It is faid that the triglyphs peculiar to this order were firft ufed in a temple at Delphos dedicated to Apollo, becaufe his lyre was of this fhape.

e, *f*, *g*, the mutule, from the Latin *mutuli*, modillion; fo that, properly fpeaking, the mutules are to the Doric the fame as the modillions are to the Compofite and Corinthian orders.

In

In the Ionic order, Plate X. there are two members which differ from thofe already mentioned, as *o* the volute, and D the dentils. The volute is fo called from the Latin *volvendo*, to roll round, as on a ftaff*. Some call the volutes the horns of the capital, becaufe they pretty much refemble the twifting of rams' horns.

The dentils are from *dentelli*, teeth, which they refemble; and the flat member on which thefe dentils are placed is termed *denticulus*.

The Compofite capital is adorned with acanthus leaves, and the Corinthian with thofe of the olive.

Of the Character and general Proportions of the Doric Order.

See Plate IX.

THE character of this order is confidered by architects as grave and robuft. Hence, in the figurative ftyle, it is termed

* The term *volume* has the fame origin, becaufe anciently they formed books by fheets of written parchment or bark rolled round a ftick.

the

the *Herculean Order*; of which order ſome temples were formerly built, and dedicated to Hercules as well as to Apollo.

It is generally uſed in large and ſtrong buildings, as in the gates of cities, and at the outſide of churches. And, as its entablature is of a very large projection, it is generally employed in ſituations where ſhelter is required.

The whole height of the entire order is divided into five equal parts; one of which is the height of the pedeſtal. The column and entablature is divided into five alſo; four of theſe parts are aſſigned for the height of the column, including the baſe and capital; theſe four parts are again divided into eight equal parts, one of which is given for the inferior diameter of the ſhaft. The entablature is two diameters in height, its cornice is forty-five minutes, and its projection is one module. The ſhaft ſometimes is left plain, and ſometimes it is fluted. The number of flutes is twenty or twenty-four, and the depth and curvature of them are determined by drawing an arch from the ſummit of an equilateral triangle, whoſe ſides are equal to the breadth of the flutes, as at *o*.

To diminiſh the flutes in proportion to the column, divide the upper two-thirds of the ſhaft into four, and find the ſemicircles 1, 2, 3, 4, 5, in the ſame manner as was taught in the Tuſcan order. Then divide each of theſe ſemicircles into ten

or twelve, and draw the flutes on each ſemicircle from the ſummits of equilateral triangles as above. Laſtly, as the Doric flutes have no fillets, all that remains is to draw a line from each point where the flutes meet, from one ſemicircle to the other, and the lines for the flutes will be thus determined. And obſerve, in all the orders a flute muſt be in the center of a column or pilaſter, not a fillet.

The triglyphs are thirty minutes in breadth, ſee Plate XII. and ſixty-two in height, including the conic drops, and the upper and lower fillets, with the ſmall ſquare above the drops. The channels of the triglyphs form a ſquare or right angle, and their breadth is determined by dividing the whole triglyph into twelve equal parts, and aſſigning two of theſe parts for the channels, two for the ſpaces between them, and one for the half channel on each ſide. The conic drops at bottom are alſo equal to two of thoſe parts; and if two parts be divided into three, one of theſe parts will be the breadth of the upper end of thoſe drops.

The metope, or ſpace between each triglyph, is forty-five minutes, or equal to the height of the triglyph without the fillets. Theſe metopes are ſometimes adorned with ox ſkulls or pateras, whoſe projections ought not to be more than the triglyph itſelf.

The breadth of the mutules, without their caps, is equal to the triglyphs without their fillets.

The projection of the mutule is the same; and the soffits, or undersides of the mutules, are sometimes ornamented with drops of the same kind as those of the triglyphs.

The soffits of the corona are also enriched with roses in square, and in * lozenge compartments, cut out of the solid, including in their depth the whole relief of the ornaments.

With respect to the heights and projections of each member, these must be learned from the upright and horizontal scales, and therefore it will be unnecessary to say more.

Of the Character and general Proportions of the Ionic Order.

See Plate X.

The Ionic is more slender and graceful than the Doric. Its ornaments, in my opinion, are truly elegant, being in a

* In the figure of a rhomb. See Plate II. fig. 3.

ſtyle of compoſition between the richneſs of the Corinthian and the plainneſs of the Tuſcan order: for which reaſon, in the figurative ſtyle, it has been compared to a ſedate matron, in decent rather than rich attire.

This order, being of a grave caſt, is often employed in courts of juſtice, and in the inſide of churches, and other places of that kind: in libraries and colleges alſo, and in all places that belong to arts and letters.

The general proportions are as follows:

The height of the entire order is divided into five equal parts. One part is given for the pedeſtal, and the remaining four are divided into ſix; one of which is aſſigned for the height of the entablature, and the remaining five will be the height of the column, including the baſe and capital. The height aſſigned for the column is then divided into nine, one of which is for the inferior diameter or module.

The cornice is forty-four minutes high, and its projection is equal to its height. The drip in the under ſide of the corona is channeled out one minute deep within two of the front, and one minute before the cyma-reverſa.

The

The ſhaft of the column is ſometimes fluted and ſometimes plain. Twenty or twenty-four is the number of flutes, allowed, and their fillets are one third of the width. The depth of the flutes is determined by a ſemicircle whoſe diameter is equal to the width of them.

How to deſcribe the Ionic Volute.

See PLATE XIII. FIG. 4.

Operation.—Draw the perpendicular A *s*, and make A *s* equal to fifteen minutes. On the center *s* deſcribe a circle whoſe diameter ſhall be equal to three and an half minutes. Draw next a geometrical ſquare, having its ſides equal to the radius of the circle, as 1, 2, 3, 4. From the angles 2, 3, draw a right line to the center of the circle, as at *s*. Divide the ſide of the ſquare 1, 4, into ſix equal parts, as at 5, 9, 12, 8. From 5 draw the line 5, 6 parallel to 1, 2; draw 6, 7 parallel to 2, 3, and 7, 8 parallel to 3, 4. In the ſame manner draw 9, 10, 11, 12, and twelve centers will be found, as at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; by which every arch of the volute will be accurately drawn, and each of them coincide with the other—thus: on the center 1 fix one foot of the compaſſes, and extend the other to A: with

 this

this opening ſweep the arch A B. On the center 2, with the compaſſes extended to B, ſweep the arch B C. On the center 3, with the compaſſes extended to C, ſweep the arch C D. On the center 4, with the compaſſes extended to D, ſweep D E, and the volute will be turned once round. For the ſecond time round, begin at center 5, and extend the inſtrument to E, and ſweep E G. On the center 6, with the compaſſes at G, ſweep G H. On the center 7, with the compaſſes at H, ſweep H I. On the center 8, with the compaſſes at I, ſweep I K, and the volute will be turned twice round.

The third time round begins with center 9, from which extend the compaſſes to K, and ſweep K M. On the center 10, with the compaſs foot at M, ſweep M N. On the center 11, with the compaſs foot at N, ſweep N O. And laſtly, on the center 12, with the compaſs foot at O, ſweep O P, which will complete the volute three times round.

Obſerve, that the whole volute is compoſed of twelve quadrants of a circle, drawn from twelve centers, and gradually contracted in by means of the diagonal lines in the eye, ſee Fig. 3. Therefore, as there are three complete turnings in the whole convolution, each of theſe turnings is made up of four quadrants.

How to graduate the Lift or Fillet of the Volute.

MAKE the breadth of the fillet at A equal to two minutes; or, according to ſome, one and ſeven eighths, or one and two thirds. Conſtruct a triangle, as at Fig. 5, whoſe ſides AP, VP, ſhall be equal to the length of the cathetus, or upright line AP, Fig. 4. Make AV, Fig. 5, equal to half the ſide of the ſquare in the eye of the volute, Fig. 4. Draw then the line LS, Fig. 5, at a diſtance from AV, equal to the breadth of the fillet at A, Fig. 4. Take the length LS from Fig. 5, and place it each way from S in the eye of the volute, or as from V to S in the large eye, Fig. 3. VS is divided into three equal parts, which are ſhewn by the dotted lines; and where theſe dotted lines interſect with the diagonal lines in the ſquare, they will find twelve new centers, which will deſcribe the diminution of the liſt or fillet by the ſame proceſs that was uſed in drawing the exterior contour or outline of the volute above explained.

For the other enrichments of the Ionic capital, ſee the plan in Plate XII. and obſerve, that over every flute in the ſhaft is placed an ove, or egg, in the ovolo.

Of

Of the Character and general Proportions of the Composite Order.

See Plate XII.

THIS order is generally placed last of the five, because it was a composition from them, and of the latest invention. But, according to this reasoning, the Doric should be first in order, because it was the most ancient; however there are two reasons which have induced me to place the Composite as the fourth. First, because it is the fourth when orders are placed upon orders in large and magnificent buildings, where it is observable that the more massive and plain columns are nearest the foundation, as first the Tuscan, second the Doric, third the Ionic, fourth the Composite, and last the Corinthian. Second, because it is the fourth in point of richness and delicacy, for as they decrease in strength they increase in richness of ornaments; their elevation above the ground is therefore regulated both by degrees of strength and richness of composition. But to give a proper sanction to this little novelty in the arrangement of the orders, it may be proper to quote some great man of this opinion. Sir William Chambers* says, " Most authors give the

* From whose excellent Treatise on Architecture I have borrowed some of the proportions which are found in my orders, as also from Mr. Richardson's.

last

laſt place to the Compoſite order, as being the laſt invented, and a compound, which of courſe ought to be preceded by all the ſimples. I have followed Scamozzi's method; his arrangement appearing to me the moſt natural; for his orders ſucceed each other according to their degrees of ſtrength, and in the progreſſion that muſt abſolutely be obſerved whenever they are employed together."

The proportions of the Compoſite, and its enrichments and delicacy, being nearly the ſame with that of the Corinthian order, in the figurative ſtyle it may be properly enough termed one of the virginal orders, and was therefore uſed in ſome temples of the female deities.

It is, however, generally employed in triumphal arches, for as the Romans compoſed this from the Græcian orders, ſo they made uſe of it in thoſe ſituations to expreſs ſymbolically their conqueſts over thoſe nations. I have therefore, in conformity to this, repreſented a trophy of war in the freeze, which I think would have a good effect placed over the center of each column, with other ornaments between them ſuited to the character of this order.

The Compoſite may alſo be employed in monuments of ſignal events, and in ſuch buildings as are intended to per-

petuate the memory of the great actions of particular persons.

The general proportions of this order are as follows:

The height of the entire order is divided into five, as usual; one of which is appropriated for the height of the pedestal. The remaining four is for the height of the column and entablature. These four parts being again divided into six, the upper one is assigned for the height of the whole entablature, and the remaining five of these parts are for the height of the column, including the base and capital. The height of the column is divided into ten equal parts, one of which is for the inferior diameter. The base is thirty minutes, without the upper astragal; and the capital is seventy minutes high, adorned with the acanthus leaves, and volutes drawn by the same method as that of the Ionic. The plan of the capital being drawn in the same manner as that of the Corinthian, I shall explain the particulars of it under that order.

The soffit of the corona is divided into square compartments, cut out of the solid, decorated with roses, &c. whose relief must not project more than the borders which inclose them. In rich compositions the soffits of the modillions are also ornamented, but their relief is not to exceed the horizontal surface, otherwise

otherwise it would greatly injure the effect of the modillion, and render the appearance of the profile of the entablature less pleasing.

Of the Character and general Proportions of the Corinthian Order.

See Plate XII.

The Corinthian, or last order, is certainly the most rich and graceful in its appearance of any other. To speak in the figurative style, it has all the delicacy of a female youth, and has therefore been termed the verginal column or order; on which account it is employed in the apartments of young ladies: but, for its richness and grandeur, it obtains a place in the palaces of kings, and the most superb buildings. It is also used in public squares, and all places of gaiety.

The general proportions of this order are as follows:

The whole height of the entire order is, as in all the others, divided into five, and one is given for the pedestal. The remaining four are then divided into six, and one part is assigned

 to

to the whole height of the entablature. The four parts which are left include the height of the column, with its base and capital, and are divided into ten equal parts, one of which is given for the inferior diameter of the shaft. The base is thirty minutes high without the upper astragal; and the capital is seventy minutes clear of the necking. The cornice is forty-eight minutes in height; and its projection the same.

The soffit of the corona is worked in square compartments, as in the Composite; but the under sides of the modillions are ornamented with an olive leaf, the same as in the capital. The abacus of the capital is sometimes fluted, and sometimes plain. The volutes sometimes rise higher than the under side of the abacus, but the capital looks best when thy are bounded by the under surface of the abacus.

The plan of the capital, and the position of the leaves as they appear on the round surface of the capital, are thus determined.—Let *de*, in Fig. E, be equal to the inferior diameter of the column: sweep the arch *eg* at pleasure; then bisect the arch by turning the sweeps *do* on the centers *eg*; draw *do*, the angular line of the capital.

From the angular line place five minutes each way, as at *m* and *n*. Take *mo*, and place it from *a* to *o*; then take the

whole ſpace *m o* in the compaſſes, and ſweep an arch each way interſecting at *p*. From the center *p*, ſweep the front of the abacus *m t*, and ſo of all the other ſides of the capital.

Take half the ſuperior diameter of the ſhaft, and with it ſweep the arch *c r e*; then extend the compaſſes ſeven minutes further, and ſweep the arch 7, which determines the projection of the firſt row of leaves. Laſtly, extend the compaſſes to ſix minutes further, and ſweep the arch 6, which will determine the ſecond row of leaves. Divide the quadrant *c r e* into four equal parts, and draw the radii *dc*, *dr*, *de*, which lines will determine the ſtem of each leaf. From the centers *c e*, draw ſemicircles, as they appear in the plan.

From *c r e* let fall perpendiculars, and the points 1, 2, 3, 4, will determine the ſituation of the leaves in the capital. Therefore take the diſtances 1, 2, 3, 4, from the plan E, and place them on the capital, as 1, 2, 3, 4, each way from the center; and from theſe raiſe perpendiculars, which will be the apparent place of the ſtem of each leaf. How the leaves are formed muſt be evident by inſpection, and therefore I ſhall not enlarge further on the ſubject.

How to draw the Scotia Moulding.

FIG. *c* is the ſcotia, whoſe height, without its fillets, muſt be divided into ſeven. On the fourth diviſion draw a line *r d* parallel with the fillets. Take the upper three parts in the compaſſes and draw a circle. Make *d a* equal *d n*, or four parts. From *a*, draw *a r p* indefinitely, cutting the aforeſaid circle at *p*. Laſtly, fix the compaſs foot at *a*, and extending the other to *p*, ſweep the arch *p n*, and the ſcotia will be completed.

The cyma-recta A is drawn from the ſummits of equilateral triangles thus: draw *v w*, and biſect it at *x*. Extend the compaſſes *x* to *v*, and turn two arches at 3, and their interſection is the center for the convex part. In the ſame manner *y* is the center for the concave part, which completes the moulding.

How the cyma-inverſa B is drawn, muſt be evident by inſpection; and with reſpect to any other kind of moulding, they are either conſidered as quadrants, or as ſemicircles, or nearly ſo; as the aſtragals, torus, ovolo, conge, and cavetto.

Obſervations

Obſervations on the Agreement of the Five Orders to each other.

THE height of every entire order is divided into five equal parts; of which one is given for the height of the pedeſtal, and the remaining four are for the column and entablature.

In the Tuſcan and Doric orders theſe four parts are divided into five, the uppermoſt part of which is for the height of the entablature; and the remaining four in the Tuſcan, are divided into ſeven, and one is given for the diameter; and in the Doric into eight, and one is aſſigned for the inferior diameter.

In the Ionic, Compoſite, and the Corinthian orders, the four remaining parts from the height of the pedeſtal are divided into ſix, the uppermoſt of which is for the height of the entablature of each order; and the remaining five, in the Ionic, are divided into nine, and one is for the inferior diameter; but in the Compoſite and Corinthian theſe five parts are divided into ten, and one is aſſigned for the lower diameter of each column.

In every order the plinth of the pedeſtal and its cornice are equal in projection; that is, one perpendicular line ſerves to determine the projection of both.

In every order, without exception, the baſe of each column is thirty minutes, or half a diameter, high; and, in the Tuſcan, Doric, and Ionic, the height of the capitals is the ſame; but in the Compoſite and Corinthian their capitals are each of them ſeventy minutes.

In every order the projection of the baſe at the bottom of the ſhaft is ten minutes; or, which is the ſame thing, the diameter of each ſhaft being divided into ſix, one of them is ſet forward for the projection of the baſe.

In every order its quantity of diminution may be the ſame, which is ten minutes; but in my examples the Tuſcan and Doric are rather more.

Laſtly, all the orders, except the Doric, have their cornices to project as much as they riſe; but in the Doric the cornice projects one quarter part more than it riſes.

Thefe remarks, if retained in the memory, may help to facilitate the trouble which neceffarily attends in drawing the five orders. Befides, it is fometimes required of a workman to give fome anfwer to his employer refpecting the general proportions of the orders; and, if he is not acquainted with as much of them as I have briefly laid down in the above obfervations, he muft of courfe look very foolifh in the eye of his querift, for he cannot then have recourfe to his book. But further, a workman who has profeffedly gone through the five orders, by drawing them under the direction of fome mafter, cuts but a poor figure in a converfation on the fubject of architecture and proportion, when perhaps, after all, he is unable to recollect one fingle particular refpecting them.

Of the general Proportions of Frontifpieces adapted to the Five Orders.

The Tufcan frontifpiece allows fix diameters from center to center of each column or pilafter, as defcribed in Plate V. and page 88.

The

The Doric allows ſix and a quarter, or one third. The Ionic ſix and a half; ſome make it ſeven and a quarter. The Compoſite ſeven; ſome allow ſeven and a quarter. And the Corinthian ſeven diameters and thirty-five minutes; or, as ſome have it, eight diameters.

Theſe different intercolumniations are nearly proportioned to the ſtrength or delicacy of each order, ſo that the aperture, or opening for the door of each frontiſpiece, is much the ſame in all the orders. For though the Tuſcan order only allows ſix diameters, yet ſix of theſe are equal to ſix and an half diameters of the Doric column. And the Corinthian, though it allows at leaſt ſeven diameters for its intercolumniation, the opening for the door-way will not, at that rate, be quite equal to ſix diameters of the Tuſcan column.

This ſufficiently accounts for the different number of diameters aſſigned by architects for the door-ways or intercolumns of the frontiſpieces adapted to each order.

The proportion of doors is generally in height twice their breadth; but, in ſome caſes, a little more height is requiſite.

The

The width of the door is divided into four equal parts; one of which is for the diameter of the column, or breadth of the pilaſter. Half a diameter is added to each ſide of the column, for the impoſt or ground which receives the projections of the plinth and capital.

Half a diameter is alſo allowed above the door to the underſide of the architrave, and one for the ſub-plinth, or the ſquare part on which the baſe reſts. According to this proportion, from the top of the ſub-plinth to the top of the column there will be ſeven diameters and an half; which will be within half a diameter of the full ſize of the Doric column, according to the order; but if there be a ſtep up to the entrance of the door, this will increaſe the column to its full height, which is eight diameters.

To the height of the column muſt be added two diameters for the whole entablature above the capital: and for every other particular reſpecting the mouldings, the reader muſt have recourſe to the orders themſelves.

General Directions for drawing the Five Orders in Indian Ink.

It is beſt to procure wove paper, becauſe its ſubſtance will bear a better ſhade, and its quality gives a more handſome appearance to a drawing, than the more common ſort. The paper ſhould be regularly damped, and paſted round the edges, ſo that when it dries it will become tight and even in its ſurface.

Proceed then to draw a perpendicular line for the axis of the column, and on this line place the ſeveral heights required. Through each of theſe heights draw, by the pencil, lines at pleaſure parallel to the baſe.

Next find the inferior diameter of the column, and afterwards the ſuperior one. From the extremities of the ſuperior diameter draw perpendicular lines upwards, and from the extreme points of the inferior diameter draw perpendicular lines downwards to the top of the pedeſtal. From theſe lines place the projection of the baſe, and from the projection of the baſe each way, draw two other perpendicular lines down to the baſe of the plinth.

Thus

Thus far the drawing is prepared for laying on the projections of the ſeveral members which take their ſpring from the above perpendicular lines, and when the mouldings are all drawn by the pencil, the ſtrokes of the pencil ſhould be tendered or made fainter by the Indian rubber, ſo that the ſtrokes of ink may be more clearly ſeen as they are drawn, and ſo prevented from being too ſtrong, which if they are, the drawing is totally ſpoiled.

If the drawing be on a large ſcale, as thoſe detached in the plates, the compaſſes may be ſucceſsfully applied in drawing the curved members; but if they are ſmall, like the finiſhed and entire orders in thoſe plates, they muſt be drawn by a fine pointed camel's hair pencil, guided by a ſteady hand.

The application of any kind of writing ink to the outlines of the drawing muſt always be avoided, becauſe it neither agrees with the nature or colour of Indian ink. The writing ink not only makes an outline too harſh in appearance, but likewiſe deſtroys the effect of the Indian ink; becauſe the water that is mixed with the Indian extracts the quality of the writing ink, and of courſe they blend together in one maſs, and the ſhadow becomes partly blue and partly black, which deſtroys the harmony of the whole. Therefore mix good Indian ink by rubbing it on a marble ſtone, and let the ink ſtand a few hours,

 till

till the groſſer particles ſettle to the bottom. Add a little water to a part of it, to make a light ſhade with; and with this light kind mark the outlines of the column, applying the hair pencil to the curved parts, and the braſs pen to thoſe which are ſtraight.

After this proceſs rub the drawing quite clean; and obſerve this as a general maxim, that the fainter the outline the better, provided it can juſt be diſcerned.

The next things to be conſidered are light and ſhadow, which are oppoſite in themſelves; but if diſconnected, no good effect can be produced in a drawing. Wherefore, where a ſtrong light is ſuppoſed, there muſt alſo be a ſtrong ſhadow agreeing with it; and where the light is weak, the ſhadow is leſs dark in proportion to it.

Rays of light do not project ſhadows contrary ways at the ſame time. Therefore the point of light muſt be fixed in the mind at leaſt, if not on the paper, from whence the rays are directed in parallel lines to the object, which produce a ſhadow on the contrary ſide to that which the light comes from. Proceed then to lay on a weak tint on that ſide of the ſhaft which is oppoſite the light; and the breadth of this tint muſt be proportioned according as the light is ſuppoſed to come, either di-

rectly

rectly on the front of the picture, or obliquely to it. If the light comes on the front, the tint is narrow; but if obliquely on the picture, the tint is broader, or comes farther on to the center of the ſhaft in proportion to the degree of obliquity. After having laid on the firſt tint according to theſe principles, a ſecond tint muſt be applied in darker Indian ink; but the dark tint muſt not be carried plump to the outline of the dark ſide, becauſe that would deſtroy roundneſs; for, in nature, all round or cylindrical bodies have a reflected light; but this reflected light is not equal in ſtrength to the direct light, wherefore the firſt or weak tint of Indian ink is ſuppoſed to be equal in degree to the reflected light, conſequently a ſmall portion of the firſt tint is left on the edge of the ſhaft, which is graduated or ſoftened into the ſecond tint, which is ſtrong, producing a maſs of ſhade, blending itſelf in regular gradation with the firſt tint towards the center of the ſhaft. After the ſecond tint is perfectly dry, a third ſtill ſtronger ſhould be applied, in order to complete a high-finiſhed drawing; but care muſt be taken to lay it on about the center of the ſecond tint, and not broad, but plump, ſoftened a little off at the edges, which will produce a ſufficient roundneſs, if rightly managed.

If the ſhaft is repreſented as fluted, its ſhading will yet require more management; but the ſame principles muſt be obſerved. In managing the flutes, it will be proper to mark their

boundaries

boundaries firſt with a nice braſs drawing-pen, filled with thin Indian ink, that it may diſtribute and paſs eaſily through the pen, leaving a very faint line on the light ſide, ſcarcely to be ſeen; but in ruling the dark ſide the ink muſt be laid on ſtronger, that the outline of the flutes may not be totally loſt when the ſhade is laid on. After the firſt tint of ſhade is applied, it will be requiſite then to touch in the dark ſides of the flutes. Thoſe on the dark ſide of the ſhaft may be done by the hair pencil; but if the drawing is on a ſmall ſcale, the braſs pen will do much better on the light ſide; becauſe, by drawing parallel lines with that inſtrument in imitation of graving ſtrokes, it will produce a ſhade in the flute more conſonant, and in better tone with the light ſide of the ſhaft, than can be performed by the hair pencil.

The flutes on the dark ſide of the ſhaft muſt not be all black, for their concavity will reflect a dim light oppoſite to their dark ſide, upon the ſame principles by which light is reflected on convex ſurfaces. Laſtly, when the flutings are thus handled, a ſecond tint of Indian ink muſt be laid on at the dark ſide, by which the flutes and fillets muſt be made to harmonize, and appear in one maſs of ſhade, without deſtroying their diſtinction. In general, the ſecond tint is ſtrong enough for fluted ſhafts, becauſe the outlines for the flutes contribute towards a ſhade themſelves.

The mouldings muſt next be conſidered: and as theſe are in a different poſition from the ſhaft, conſequently the light muſt ſtrike them differently.

In the examples given, I have ſuppoſed the aperture, or point of light, above the top of the column; which is a ſituation highly advantageous to the drawing, becauſe, upon this principle, there will be a regular ſtrong ſhadow under each covering member productive of a good effect.

Hence, in the Ionic, for inſtance, the hollow, or upper part of the cyma-recta, has a ſtrong ſhade; and the ſwelling part is light in the center, bearing a ſhade downwards as it recedes back. The corona is alſo light, becauſe the rays come full upon it; but the cyma-reverſa, dentils, and ovolo, are all in ſhadow, on account of the large projection of the corona, which ſcreens them from the light. The left hand volute projects a ſhadow on the ſhaft, and the curved top of each flute does the ſame. The lower ends of the flutes are light, for the rays come full upon them; but the upper part of the ſcotia in the baſe bears a ſtrong ſhade, becauſe it is totally covered by the projection of the upper aſtragal.

The cornice of the pedeſtal is nearly all in ſhadow; but the

 baſe

baſe is nearly all light, for there is nothing to prevent the rays falling upon almoſt every part of it.

Theſe obſervations, with the exerciſe of a little taſte and good ſenſe, will, I preſume, enable the learner to accompliſh his attempt to ſhade the five orders in ſuch a manner as will do him credit.

END OF THE FIRST PART.

THE

CABINET-MAKER AND UPHOLSTERER'S DRAWING-BOOK.

PART II.

ON PRACTICAL PERSPECTIVE APPLIED TO THE ART OF REPRESENTING ALL KINDS OF FURNITURE IN DIFFERENT SITUATIONS: COMPREHENDING A REGULAR AND FAMILIAR TREATISE ON THIS USEFUL SCIENCE, DIGESTED AGREEABLY TO THE AUTHOR'S OWN EXPERIENCE IN THE ART FROM SOME YEARS PRACTICE, AND FROM OBSERVATIONS ON THE PRINCIPAL WRITERS ON THE SUBJECT; VIZ. DR. BROOK TAYLOR, DR. PRIESTLEY, MALTON, KIRBY, NOBLE, AND SOME OTHERS.

INTRODUCTION.

THAT the knowledge of perſpective is highly uſeful to Cabinet-makers, Upholſterers, Chair-makers, Joiners, and other perſons concerned with deſigning, cannot be diſputed on good grounds. And, though this is an indubitable poſition, yet many in the above profeſſions are not ſufficiently, if at all, acquainted with it. This defect in their education, or neglect in their own application, neceſſarily ſubjects ſuch to conſiderable

 diſadvantages,

disadvantages, both with respect to giving and receiving orders. A master cannot possibly convey to the workmen so just an idea of a piece of furniture by a verbal description, as may be done by a good sketch, proportioned according to the laws of perspective, and situated so as to give the most general and clear view of the whole piece. Nor, on the other hand, can a workman so well understand the meaning of a drawing, and what it is intended to represent, without some knowledge of the art I am pleading for; and consequently his progress in executing the work will be proportionably retarded, and, perhaps, not so exactly finished at last. On these accounts it is a master's interest to know perspective himself, and to have men about him that understand it. When this is the case, time is often gained, stuff spared, and disgrace avoided; since it is matter of fact, that many alterations in pieces of work of every kind take place; sometimes owing to bad sketches or drawings, and sometimes from want of understanding a good design when it is given to work by. There are some masters, indeed, who will scarcely allow their foremen time to make any kind of sketch; but, if I may offer my opinion on this head, I must say that such a method of carrying on business neither reflects honour on the foreman, nor in the end turns out to any advantage to the master; but, on the other hand, frequently a considerable loss.

Befides, as it is the prefent mode to introduce much painting in furniture, it is of great ufe to know perfpective, in order to underftand when fuch painting has its proper effect, and to enable the director of work, whether mafter or foreman, to point out fuch improprieties as may efcape the notice of the painter; and which, if entirely overlooked, might prove injurious to the work, and offenfive to a cuftomer of tafte.

To thefe we may mention another advantage that often arifes to a mafter from knowing this art; fince, by it, he may often fix the judgment and mind of a gentleman or lady refpecting the piece of furniture they wifh for, by producing either a drawing that has been previoufly made, or by being able, off hand, to furnifh their ideas with a good pencil fketch. In fhort, a good perfpective drawing may be fent to a gentleman or lady in the country, with almoft as much confidence of fuccefs as if a model of the piece of work were fent.

Laftly, if the reader confider himfelf a gentleman, or as poffeffed of a liberal education, and at the fame time entirely unacquainted with this fine art, it will carry in it an air of contradiction; becaufe perfpective is founded on geometrical and optical reafoning, and has therefore always been confidered as a branch of the mathematics and of a liberal education. Yet it is my intention not to treat the fubject mathematically,

 becaufe

becaufe many have done it already in fuch a manner as far exceeds any thing I can pretend to; and becaufe it would not fuit workmen, for whom the following treatife is intended. If, however, any other above this fphere can reap any information from it on account of its fimplicity, I fhall be happy to have ferved them; but if he be above receiving inftruction through that channel or medium which is only intended to convey the knowledge of this art to workmen, the reader may confult fome of thofe authors referred to in the title, where he will fee problems, theorems, demonftrations, and corollaries enough to fill his leifure hours with, and to carry the fcience to any length he pleafes. However, to look into fome of thefe books would greatly difcourage many workmen, and even fome others of a higher clafs, who diflike the drudgery of perufing and comparing an infinite number of references to a variety of fchemes, which are rather more calculated to fhew how far the fubject may be carried by mathematical fkill, than to inform the reader of fuch principles as may be wanted in the practice of the art, or to give him a tolerable view of the theory on which the fcience is founded.

And it may be affigned as one reafon why the fubject of perfpective is fo little known amongft workmen, that it has been treated too mathematically. For, though geometry muft affift in ftating theories, and in making new and additional dif-

coveries

coveries of the principles of the art, yet we muſt not infer from hence that a workman cannot learn the practice of the art without being acquainted with that ſcience.

Malton ſays the ſame thing in the preface to his Treatiſe on Perſpective. "Perhaps," he obſerves, "the demonſtrations of the laſt (meaning the laſt theorem of his fourth ſection) may deter thoſe who are not geometricians from examining it with that attention it requires; let ſuch remember, that, in order to practiſe perſpective, it is not abſolutely neceſſary to be a geometrician, becauſe I practiſed it long before I underſtood geometry."

In fine, I ſhall only ſay, that it has been my aim to put into the hand of the ingenious workman ſuch a view of the ſubject of perſpective, applied to as general a variety of caſes, as may enable him to get through with deſigning any thing he meets with in the courſe of his buſineſs: and if any thing more than this be found in this treatiſe, the reader will ſee more than what is promiſed; which may probably incline him to acquieſce with the author's ſentiment, that it is better to do more than we ſay, than fall ſhort of what we have promiſed.

SECTION I.

Of the Principles on which Perſpective is founded, and the Definitions of thoſe Terms neceſſarily uſed on the Subject.

THE principles on which the art is built are founded on the nature of our ſight, which invariably comprehends all objects under ſome angle of a leſs or greater degree, in proportion as the object is at a greater or leſs diſtance from the eye of the ſpectator.

Hence let A, Fig. 1. Plate XIV. be conſidered the human eye, which is nearly globular; and P the pupil *, or that extremely ſmall point of the eye into which the rays of light iſſuing from every part of illumined objects in right-lined directions all converge.

* The term *pupil*, in general, means a youth or minor under the tuition and management of a maſter or guardian, but why it has been introduced into optics, and applied to the aperture or ſmall opening of the eye which receives the light, is owing to the little image— or *pupilla*, a puppet—which is reflected in the eye, and ſeen by every one who looks ſteadily on it, which is no other than the ſpectator himſelf, whoſe image in miniature is reflected on the cryſtalline humour.

Thus

Thus the rays BP and DP, iſſuing from the ſerpentine figure BD, are ſaid to converge, becauſe they unite in a point at P, the pupil; and, after paſſing through the pupil and continuing in their direct courſe, they diverge or ſpread open as at *n m r q v t*, on that part of the eye called the retina*, by which an object is formed ſimilar to the originals BD, EC, FG, and in magnitude according to their different diſtances from the eye †. Therefore, as the firſt object BD is neareſt to the pupil P, the points *n t* on the retina are moſt extended, becauſe the angle DPB, under which the object BD is ſeen, is conſiderably larger than thoſe under which the objects EC and FG are ſeen.

And again, as the ſame object is removed back to EC, the rays are leſs extended on the retina as at *m v*; but if the object be removed ſtill further from the ſight P to FG, the rays will ſtill diverge leſs, and conſequently the object painted on the retina will be proportionably ſmaller as at *r q*. And thus, by removing the object FC ſtill further and further from the ſight, it would be ſeen under a proportionably ſmaller angle, until

* Retina, from *rete*, a net; becauſe this part of the eye is a fine expanded membrane, ſomewhat open like a net, and ſpread over the bottom of the eye, on which are painted the pictures of all the objects we perceive.

† The refraction of the rays of light occaſioned by their paſſing through the different mediums or humours of the eye, has nothing to do with perſpective, it belongs to optics only, on which Ferguſon's Lectures may be conſulted, and others on the ſubject.

it would at length vaniſh into a point, and loſe its appearance.

That the rays of light, by which we are made ſenſible of objects, make their way to the organs of ſight in right-lined directions, is evident from a moſt ſimple experiment: for, if the bore of a tube or pipe be as much curved as is equal to the diameter of the bore, nothing can be ſeen through it; or if one object ſtanding before another of equal magnitude on the ſame line, be viewed by a perſon ſtanding on that line, the laſt will be hid, provided they both ſtand upright. I ſimply mean, if the ſhafts of two columns of equal diameters were placed upright, and a ſpectator were ſtanding upright on a line paſſing through the centers of each ſhaft, the laſt one could not be ſeen; but if viſion, or the faculty of ſeeing, were performed by rays of light in curved directions, perhaps this would alter the caſe, but not for the better, as I am certain that the conſtruction of our eye, and the way in which we, at preſent, diſcover objects, are the perfect productions of Infinite Wiſdom.

From what has been ſaid and referred to in the figure, I preſume that the reader is not altogether ignorant of theſe two things: firſt, that all objects appear to the ſpectator proportionably leſs the further they are removed from the eye; and, ſecond, that the rays of light coming from every part of il-

lumined objects operate on the eye in right-lined directions. These two propositions being admitted as certain truths, two very considerable points in perspective will hereby be gained. First, that in the representations of objects originally of the same dimensions, those which are furthest from the front of the picture must be least, in proportion to the supposed or real distance of the spectator's eye from the object: and second, that a right line from the top and bottom of the front objects, terminating in a point on the horizon, will determine the heights of all those back objects which are originally of an equal height with those on the front.

Hence, if a range of columns be represented on a picture, a right-line from the top and bottom of the first column to some point in the picture, will determine the heights of all those behind. Experience will convince us of the truth of this: for if we place ourselves at a distance from a straight row of columns, standing a little to one side, and looking attentively from the first to the last column, we shall then see that the pillars will appear to diminish backward in the form of a triangle; or, in other words, the tops and bottoms of each column will seem to tend to one point.

The same may be observed by standing close to a long brick wall, and ranging the eye along the joints of the bricks; we

ſhall ſee each joint ſeemingly terminating into one point. Thoſe joints below the eye will appear to riſe up, and thoſe above it will ſeem to lower; and if the length of the wall were continued as far as we could ſee, the joints would apparently unite in one point.

Theſe ſimple experiments cannot be accounted for upon any other principle than that which I have already advanced on the nature of viſion; namely, that all objects, as they recede from the eye, are ſeen under a ſmaller angle in proportion to the diſtance of the object from the eye. This propoſition holds good, not only as it relates to the heights of objects, but alſo to their breadth and thickneſs, for theſe are diminiſhed or contracted by the ſame rules, founded on the nature of our ſight. Nor are theſe remarks to be reſtricted to ſuch objects as ſtand upright on the ground, for thoſe which are horizontal in their poſition, or which are lying in various ſituations on the ground, are all ſubject to the ſame laws of diminution. But it muſt here be obſerved, that the various poſitions of objects give birth to moſt of thoſe imaginary planes which are introduced into the ſubject of perſpective; for in theſe planes all the variety of objects that we can conceive of, are ſuppoſed to be ſituated, ſome in the ground-plane, and others parallel to it, both above and below the horizon; ſome in upright, and ſome in oblique or inclining planes. And this variety of planes ſhould be under-

ſtood

ftood and carefully diftinguifhed by the learner, before he can make any good progrefs in the art, or know what he is about, when he begins to reprefent.

Thefe planes are again bounded by fo many right lines, of which they are compofed; and thefe lines have their names, anfwering to their intended ufe in the practice of perfpective.

Since, therefore, planes, lines, and points, comprehend the whole art of perfpective, it will be requifite to define thefe in as clear a manner as poffible. The reader will, perhaps, imagine here, that I am drawing him into the ftudy of geometry, as an effential requifite to the practice of perfpective, and thereby contradicting what I have already advanced in the preface. If, indeed, to exercife our reafoning faculties, and to make ufe of a little common fenfe, be termed the ftudy or knowledge of geometry, I will aver that no man will ever learn perfpective without thefe. But, this every one knows; that many can exercife both good fenfe and reafon who never faw nor heard of Euclid.

Befides, if the reader has attended to the firft part of this work, in which lines, fuperficies, and folids, have been touched on in a general way, he cannot be confidered as totally ignorant

of ſome part of geometry which is uſeful to the knowledge of perſpective; however, as I have ſaid nothing of planes and their interſections, I ſhall here explain them, ſo far as they relate to the ſubject of perſpective.

Of the Nature of Planes relative to the Subject of Perſpective.

A plane, ſtrictly ſpeaking, is an even ſurface, neither concave nor convex, but which will agree with a ſtraight ruler or line every where.

A plane, in theory, may be conſidered indefinitely, or definitely. When it is ſuppoſed to be indefinite, it admits of no bounding lines, but is imagined to be continued without limits.

When it is defined, its boundaries are limited by lines, as AB, BO, OD, and DA. Fig. 2.

In perſpective there are five planes principally in uſe, according to Dr. Brook Taylor's ſyſtem; but the various circumſtances of objects in the picture frequently produce a variety of others, which, however, are not termed the elementary planes, as the above five may, but only accidental, depending on the circumſtances of objects.

Of the Ground Plane.

In the order of theſe planes I ſhall conſider the ground plane firſt, being commonly a horizontal ſurface on which original objects have, in general, their ſeats or foundations; as 1, 2, 3, 8, is the ſeat of the caſe of drawers on the ground plane AB, DO, Fig. 2.

The Doctor terms the ground plane the original plane, "By which," he ſays, "we mean the plane wherein is ſituated any original point, line, or plain figure." I ſhall, in general, however, uſe the term ground plane, as being more ſimple, except in caſes where no regard is paid to its being horizontal; then, indeed, the term original plane muſt be uſed, being more comprehenſive, as it includes any poſition.

Of the Perſpective Plane.

Second, the perſpective plane, otherwiſe called the plane of the picture; which, in general, is a plane perpendicular to that of the ground, as GR, HL.

This plane is to perſpective what the retina is to optics; for the images of all original objects are delineated on both.

The

The perſpective plane may be conſidered as ſome tranſparent medium placed upright between the object we view and our eye; and as the rays of light coming from every point of illumined objects converge, in right-lined directions, to a point on the pupil P, Fig. 2, a ſection of thoſe rays, produced by this tranſparent medium or perſpective plane, is the perſpective repreſentation of the original object, be it what it may.

Hence, let the learner place himſelf before a glaſs window, which is, properly ſpeaking, the perſpective plane to every object he looks at through it; and as thoſe objects appear to him on the window, ſuch is their perſpective repreſentations on the paper, board, or canvaſs, we draw on. The appearance of objects on a window may be found by gumming the glaſs, which does not deſtroy its tranſparency, but makes it capable of receiving a mark; and if the eye be kept perfectly ſteady to one point in the window, and, with a pencil, the points or angles of a houſe, for inſtance, be marked as they appear on the glaſs; and when this is done, if right lines be drawn to each point, theſe lines will form the perſpective of the houſe.

Thus the plane GR, HL, may be conſidered a piece of gummed glaſs fixed upright on a table or ground AB, DO; and at P is the ſpectator's eye, viewing through the glaſs the original object 1, 3, 5, 7. The right lines iſſuing from every part of the object and converging at P, repreſent the rays of

light paffing through the tranfparent medium to the eye P. Now, as the original object is defcribed on the glafs by the direction of thefe rays, if the fpectator, with his hand, mark the points 1, 3—5, 7, 4—6, and afterwards join the points by right lines, this will be the exact perfpective reprefentation of the original object.

Simple experiments of this fort fhould be practifed, as I am perfuaded they are more calculated to teach the principles of the art than long and tedious theories *.

Of the Horizontal Plane.

THE horizontal plane, or plane of the horizon, is, in perfpective, an imaginary plane paffing through the eye of the

* An artift lately informed me, that a piece of ground glafs, unpolifhed, and oiled over with fweet oil, is the beft for this purpofe; for the oil gives a degree of tranfparency to the glafs that admits of objects being feen through it, and its artificial roughnefs makes it eafy to draw on. If a fquare of glafs of this fort be put in a flight frame of wood, fixed upright on a plain board, and there be a fight-hole made in a piece of wood fixed perpendicular to the fquare of glafs; and if the fight-hole be fixed from the glafs equal to the diftance P *s*, and to the height of the eye P N, then every thing which relates to Fig. 2, may be proved by ocular demonftration, provided the learner ufe this little inftrument according to the references made to this figure in the different heads of this fection.

ſpectator, and being perfectly parallel with the ground plane, it cuts the upright picture or perſpective plane at right angles.

Thus, in Fig. 2, Plate XIV. F H, L M, is the horizontal plane, whoſe perpendicular height from the ground plane A B O D is the height of the eye at P; hence P N is the perpendicular height of the eye, becauſe the line P N is perpendicular to both theſe planes.

The horizontal plane F H, L M, being produced, it neceſſarily cuts the perſpective plane G H, L R, at right angles, and the interſection of theſe two even ſurfaces or planes with each other being a right line as H L; hence we have what is commonly called the horizontal line H L; or, more properly, the vaniſhing line of a plane parallel with its original. And as the interſection of the horizontal with the perſpective plane produces the vaniſhing line H L, ſo the interſection of the picture with the ground plane produces the baſe or ground line G R.

All original objects, as they appear to come into the plane of the horizon, gradually vaniſh into a point, and diſappear. Hence the application and uſe of the term horizon in perſpective, which literally means the limits or boundaries of our ſight, from " ὁρίζω, *borizo*, I limit or bound." The further objects are repreſented from the front of the picture, or from the

ground

ground line G R, the nearer is their approach to this plane, and consequently their apparent magnitude will be proportionably less, as has been already demonstrated in page 183. For if the case of drawers, in Fig. 2. were removed considerably further from the perspective plane G R H L, it is evident that the rays 1 P, 3 P, 5 P, 7 P, &c. would not subtend * so large an angle on the plane of the picture as they do at present: it is also manifest that these rays will also rise higher on the picture in proportion as the case of drawers or original object is removed back, consequently the image 1, 3, 5, 7, of the drawers on the picture would approach nearer to the horizontal plane, until at length the image on the picture would totally vanish at *s*, the center of the picture and height of the eye.

To understand this yet more clearly; suppose the drawers to be brought forward close to the picture, then the foot 1 would be at 10, and the foot 3 at 12, on the intersection or ground line G R, and the image of the original object would then appear as large on the picture as the original itself; for then the point 5 on the drawers would be at *a* on the picture, and the point 7 at *b*; but the whole image of the original, in this case, is lower on the picture than before, and consequently farther from the horizontal plane, which was to be shewn.

* From *sub* and *tendo*, I stretch. The subtense of an angle coincides with the chord of the arch. Thus the object B D, Fig. 1, subtends an angle of 60°, for the rays B P D P cut the arch in that proportion, and therefore the object B D is said to be seen under an angle of 60°.

From what has been ſaid, it is obvious that the whole ſpace on the plane of the picture for delineating objects, is comprehended between the ground line G R and the horizontal or vaniſhing line H L. No object can with propriety have its ſeat on the picture below the line G R, for this line is the interſection of the ground plane with the plane of the picture; and therefore, to repreſent the caſe of drawers lower than at 10 and 12 on the ground line G R, would lead us to ſuppoſe a new ground plane below the firſt, and a new horizon to ſuit it, otherwiſe the drawing would be unnatural and diſtorted.

On the other hand, no original object can have its ſeat in the perſpective plane higher than H L, for the line H L marks out the interſection of the horizontal with the perſpective plane; and as the plane of the horizon is generally the vaniſhing plane of all original objects ſituated on the ground, their ſeats in the picture cannot be above the vaniſhing line H L, without producing worſe effects than in the other caſe juſt mentioned. For if the images of all original objects, however large, vaniſh into a point *s* in the vaniſhing line H L, it would be prepoſterous to ſee a tall object ſeated on this line, or above it.

Before I quit this head, it will be proper to obſerve, that the horizontal plane, on which I have ſeemingly laid ſo much ſtreſs, does not poſſeſs any thing peculiar to itſelf, owing

to its being confidered a plane, perfectly level; for all the various pofitions of vanifhing planes make no difference in theory, provided they are confidered as parallels to original planes. It is the pofition that thefe planes have to each other that is to be regarded. This was one principal difcovery which Dr. Brook Taylor made in his new fyftem of perfpective, and which has rendered his principles fo univerfal. In his book he fays, "He makes no difference between the plane of the horizon and any other plane whatfoever; for fince planes, as planes, are alike in geometry, it is moft proper to confider them as fo, and to explain their properties in general, leaving the artift himfelf to apply them." Yet it may be obferved, that we have a natural prejudice in favour of fomething peculiar to the horizontal vanifhing plane; becaufe, in nature, the laws of gravity fettle all folid bodies in a horizontal pofition: this being the cafe, we are accuftomed to view objects in this form, and of courfe are required to draw them fo; therefore, in the practice of perfpective, the horizontal vanifhing plane is generally wanted; but in principle and theory, the relation that one plane has to another is only to be regarded.

Of the Directing Plane.

The directing plane is imagined to be parallel with the picture, whatever position it is supposed to be in; and its distance from the plane of the picture is equal to the distance of the eye of the spectator; therefore it is considered as a plane passing through the eye, as the plane MFVU, Fig. 2. Hence, if any original line ZX be produced till it cut the directing plane MFVU, a line drawn from Y, where it intersects, to P, the place of the eye is termed the directing line of that original line ZX.

And the representation of any original line in the plane of the picture is always parallel with its directing line in the directing plane.

Of the Vertical Plane.

In perspective, the vertical plane is considered as perpendicular both to the ground plane and the plane of the picture; consequently it cuts the other four at right angles. The plane

PsQN,

P*s*QN, Fig. 2, is thus termed geometrically, becaufe it is in a direction perpendicular to the horizon; but in perfpective it may be in any pofition, provided it be perpendicular to the original and perfpective planes, and at right angles with the other.

The interfection of this plane with the picture HLGR produces the perpendicular line *s*Q, termed the vertical line of the picture; and the vertical plane being continued till it cut the directing plane in the line PN, that line PN is the interfection of the vertical with the directing plane; and as *s*Q, the vertical line of the picture, is parallel with PN the interfection of the vertical with the directing plane: PN is therefore the directing line of *s*Q, the vertical line of the picture.

Vertical planes have vertical vanifhing lines when the picture is perpendicular to the ground plane; in which cafe the vertical line *s*Q is continued to a length above and below the horizon HL, that will admit the neceffary vanifhing points.

Of the Visual Plane.

To theſe planes already deſcribed may be added the radial or viſual planes.

A viſual or radial plane, is ſuch as paſſes through the eye, and any original line whatever.

A plane may be continued by any three points. The three points P X Y are the interſections of three right lines; and, according to geometrical reaſoning, when three ſuch lines meet each other, as the lines P X, X Y, and Y P, they are all in the ſame plane. This, among geometricians, is an axiom or ſelf-evident truth, and therefore needs no demonſtration.

The continuation of the plane P C Y X, which the triangle Y P X is in, till it interſects with the plane of the picture, is therefore the viſual or radial plane of the original line Z X; and the line *v* 16, produced by the interſection of the viſual plane with the plane of the picture, is termed the viſual line of the original Z X.

As I have already obſerved and proved that the appearance of objects on the retina is conveyed by rays of light flow-

ing from every point of any object to the eye in right-lined directions, fee page 184; let the right lines X P, Z P, be confidered as the rays of light coming from the original object Z X, and converging at P; but thefe rays are cut or interfected by the plane of the picture G R H L at *x z*, therefore the line *x z* is the projection of the original object Z X on the plane of the picture; or, in other words, it is the perfpective reprefentation of the original object Z X: for the reprefentation *x z* of the original line Z X is in the line *v* 16, which is the interfection of the vifual plane P C Y X with the plane of the picture: and fince the line P C is the parallel of the original line Y X, where P C cuts the plane of the picture at *v*, proves that the line *v* 16 is the true line of interfection produced by the vifual plane cutting the plane of the picture. Hence the line *v* 16 is, in perfpective, termed the vifual line, from *vifio*, I fee; for the lines P Z, P X, are the rays of light by which vifion is performed, or by which we perceive objects, and as the interfection of thofe rays is in the line *v* 16, fo this line *v* 16, drawn on the picture, is properly termed the vifual line of its original Z X.

Of

Of the Lines in Perſpective generated or produced by the foregoing Planes.

I HAVE already ſpoken of theſe lines in the explanation of the ſeveral planes to which they are related; but it will alſo be requiſite to ſum them up here, that the learner may have a more clear view of them from what has been ſaid.

Firſt.—The ground line G R, is a line produced by the interſection of the picture or perſpective plane H L G R with the original plane A B D O. It may alſo be ſimply termed the interſection of the picture; but ſome chooſe to call it the entering line.

Second.—The vaniſhing line H L, commonly called the horizontal line, is produced by the interſection of the vaniſhing plane F H M L with the plane of the picture H L G R.

Third.—The parallel of the eye F M, is a line produced by the interſection of the vaniſhing plane with the directing plane U V F M; and as this line is the interſection of a plane paſſing through the eye always parallel to the picture, conſequently

F M

F M is always parallel to the vanishing line H L, and of equal height to it.

Fourth.—The directing line U V is the intersection of any original plane A B D O with the directing plane U V F M.

Fifth.—The vertical line Q *s* passing through the center of the picture *s*, is the intersection of the verticle or upright plane P N *s* Q with the plane of the picture; and P N, the perpendicular height of the eye, is the intersection of the vertical with the directing plane.

Sixth.—The visual line *v* 16, is produced by the intersection of the visual plane P Y C X with the plane of the picture, and is therefore the indefinite representation of the original Z X.

Seventh.—The director of an original line. If any original Z X be produced till it cut the directing plane U V F M, a line P Y is termed the director of that original line Z X.

Eighth.—The radial line*, or parallel of any original line Z X. In whatever degree of obliquity the original line Z X intersects the ground line G R, in the same degree of inclination

* Radial, from ῥαβδος, *rabdos*, or *radius*, a ray of light.

will the radial Pv cut the vaniſhing line HL; for Pv is parallel to the original line ZX.

Of Points, in Perſpective, produced by the Interſections of the preceding Lines.

As the interſections of planes with each other generate or produce lines, ſo alſo lines meeting or cutting each other produce points.

Hence the following points in perſpective are produced by the interſections of the lines which we have now defined.

Firſt, the point of ſight, or the place of the eye; P is that point where the ſpectator's eye ought to be placed in viewing the picture. Hence, if through the eye P a line perpendicular to the original plane be produced till it cut the parallel of the eye FM, their point of interſection is the point of ſight P.

Second, the center of the picture. If from the point of ſight P a line be drawn perpendicular to the picture, and be produced till it cut the vaniſhing line HL, their interſection will be the point s, or that point termed the center of the picture;

ture; and the diſtance between the point of ſight P, and *s*, the center of the picture, is called the diſtance of the picture; and the line itſelf which meaſures this diſtance, may be termed the direct radial.

Third, the vaniſhing point. If, from the point of ſight P, a line be drawn parallel to any original Z X, and is produced till it cut the vaniſhing line H L, their point of interſection *v* is the vaniſhing point of the original line Z X; becauſe, if the original line Z X were infinitely produced on the ground plane A B D O, its image Z X on the picture would at length vaniſh or diſappear to the eye P in the point *v*. The line which meaſures the diſtance between *v* and P, is the diſtance of that vaniſhing point *v*; and the line itſelf may be termed the oblique radial, becauſe its original Z X is oblique to the picture.

Fourth, the point of interſection. If the original line Z X be produced till it cut the ground line G R, that point 16 where the line G R is cut, is called the point of interſection: and if the original line Z X be ſtill continued till it cut the directing line U V, the point Y, where they interſect, is termed the direct-point of that original Z X.

Laſtly, The point of ſtation. If from the place of the eye P, a line be drawn perpendicular to the ground plane

at N, that point N is the point of ſtation, or foot of the ſpectator.

I ſhall conclude this ſection with adviſing the reader to make himſelf well acquainted with the preceding planes, lines, and points, before he proceed further: which, if he do, it will enable him to read the ſubſequent pages more eaſily, and often prevent the trouble of referring to the plates. Add to this, it will make him underſtand more readily the problems and operations of both this and other publications on the ſubject.

SECTION II.

The Affinity and Agreement between Optical Laws and the Principles of Perſpective demonſtrated—And alſo of the Uſe of the three principal Elementary Planes in the Practice of Drawing—ſhowing, that all that is exhibited by the natural Poſitions of theſe Planes in Fig. 2, may be correctly drawn on any even Surface without their Aid.—Of the various Poſitions of Lines and Planes to the Picture, and of the Principles of Vaniſhing Points agreeing therewith.

Of the Affinity of Optical Laws with the Principles of Perſpective.

IN Section I. page 183, it has been ſhown that all objects appear proportionably leſs as they are farther removed from the eye; and as the reader is now ſuppoſed to be acquainted with the planes, lines, points, and terms, which have been explained in the preceding ſection, I ſhall proceed to ſhow that the rules of perſpective agree with optical laws.

Thus:

Thus: let G R, Fig. 4, be the ground line, and H L the horizontal or vaniſhing line, whoſe height above the ground line is equal to that of the eye of the ſpectator; *s* is the center of the picture, and *s* D the diſtance of the ſpectator's eye from the object *b d*. Draw *d b* perpendicular and equal to B D, Fig. 1, and as much to the right hand of *s* as D, in Fig. 1, is to *e*. Then, in Fig. 4, draw the viſual lines *d s* and *b s*; which lines are to determine the heights of the two original objects, E C, F G, in Fig. 1. Then take the ſpaces D C, C G, from Fig. 1, and transfer them to Fig. 4, from *a* to *a*, and from *a* to *n*, on the ground line G R. Draw the lines *a*, D, *n* D, cutting the viſual line *d s* in *g c*; and laſtly, from *g* and *e* on the viſual *s d*, raiſe perpendiculars to *s b*; then will *g*, *f*, *c*, *e* be the perſpective repreſentations of G F and C B in Fig. 1.

The analogy between the two figures will appear as follows.—In optics, P, in Fig. 1, is the pupil, and P *e* the direct radial or axis of the eye, and equal to the diſtance of the firſt object D B from the eye. In perſpective, D, in Fig. 4, is the ſame as P in optics, Fig. 1; and, in Fig. 4, *s*, the center of the picture in perſpective, is the ſame as *e* in Fig. 1. Therefore as P *e* in optics is the direct ray, and the diſtance of the firſt object D B from the pupil P, ſo *s* D, Fig. 4, in perſpective, is the diſtance of the ſpectator's eye from the picture. In optics, if the ſecond object C E is removed twice as far from the eye P as the firſt

object D B is, its image $m\ v$, on the retina, will be little more than half the length of the image $t\ n$ of the firft object DB on the retina; and, in perfpective, Fig. 4, the reprefentation $c\ e$ of the fecond object C E, is exactly half the length of the firft object D B, as Fig. 4 demonftrates, and which coincides with Fig. 1; for obferve, the rays of light P E, P C, coming from the fecond object to the pupil P, cut D B, their fection, in the fame proportion as the vifual lines $s\ d$, $s\ b$, of Fig. 4, cut the perpendicular $c\ e$. Hence the fpace 2, 7, on D B, is equal to the reprefentation $c\ e$, Fig. 4; and in the fame manner the fpace 1, 8, where the rays of light from F G cut the picture D B, is equal to g, f, Fig. 4, the reprefentation of G F, Fig. 1.

Laftly, the reprefentations $g\ f$, $c\ e$, in Fig. 4, approach to the center s, in the fame proportion as their originals G F, C E, in Fig. 1, approach to e, the center of the imaginary plane B D, which is fuppofed to cut the rays of light P C, P G, at 2, 1; for the fpace D 2 and 1 on Fig. 1, is the fame and equal to d, 2, 1, on Fig. 4; fo alfo is d, e, Fig. 4, to D e, Fig. 1. And hence it may be concluded, that the rays P C, P G, are to their fection D e, Fig. 1, as the vifual line $d\ s$ is to its dividers or meafuring-lines D a, D n, Fig. 4.

Before I conclude this head, it will be proper to obferve, that notwithftanding the general agreement between optical

laws

laws and the rules of perſpective, yet in one reſpect there is a difference, for the perſpective repreſentation of any object on a plane, is not the ſame exactly with the appearance of that object to the eye; and therefore, in alluſion to this difference, I have, in the preceding page, already ſaid, "In optics, if the ſecond object C E is removed twice as far from the eye P, Fig. 1, as the firſt object D B is, its image *m v* on the retina will be little more than half the length of the image *t n* of the firſt object D B; but the repreſentation 2, 7, of C E on a plane D B, which is the ſection of the rays P C, P E, is only half the length of the firſt object D B, as the figure itſelf demonſtrates." The reaſon of this difference is owing to the eye being a ſphere, but a picture a level ſurface or plane; for the rays P C, P D, cut the arch or ſphere K L at 6, 5, in a different proportion to what they do on the plane B D, as is plain; becauſe the ſpace D 2, which is the repreſentation of the ſpace D C on the plane B D, is greater than the ſpace 6, 5, on the ſphere K L; which ſpace 6, 5, is the appearance of the ſpace D C to the eye; but the ſpace D 2 is its repreſentation on the picture. This difference, however, decreaſes the further the object is removed from the eye, for then the rays do not cut the picture ſo obliquely; conſequently the repreſentation of the original object on the plane of the picture is more natural, becauſe it has more of the appearance of that real object to the eye. Thus: if the object E C be removed back to F G, the rays P G, P F, are leſs

oblique

oblique to the picture B D; and therefore the repreſentation 1, 8, on the picture B D, is nearer to its true appearance *o b* on the arch K L, than the repreſentation 2, 7, is to its true appearance 5, 11, on that arch; but much more does this difference appear between the firſt object B D and its real appearance *y*, 60, on the arch K L, which yet would be conſiderably more if P were removed to Z. Hence the neceſſity of chooſing a proper diſtance for the repreſentations of objects on a picture, that their appearance on the picture may be nearly the ſame as the real objects have to the eye. This will be touched on in its proper place.

The difference then between the repreſentation of objects on a plane and their appearance to the eye, which is a circle, is as the difference of the tangent of the arch, which comprehends the angle under which the object is ſeen, is to the ſubtenſe of that angle. Thus: let D C be the object viewed at P, then will 6, 5, on the arch K L, be the opening or ſubtenſe of the angle under which the object D C is ſeen, which meaſures fourteen degrees; and D 2, the repreſentation of DC on the plane BD, is the tangent of that arch 6, 5, which comprehends the angle under which D C, the object, is ſeen.

 From

From what has been ſaid on this ſubject, it is evident that a perfect picture of objects, as they appear to the human eye, cannot be delineated on a plane. It may be done on the ſurface of a ſphere, when the eye of the ſpectator is ſuppoſed to be in its center; for then every part of the picture would be equidiſtant from the eye, and every ray of light perpendicular to its own ſurface, as are the rays *y* P, 11, P, &c. of the ſphere K L. None of the rays, in this caſe, could cut the picture obliquely, and conſequently no diſtortion would appear. But though this be the caſe, yet it will not afford any ſolid objection to the certainty of perſpective rules adjuſted to a plane; for, by the help of light and ſhadow applied in different degrees of ſtrength to objects as they are more or leſs remote from the eye, and by a judicious choice of the diſtance, a picture may be drawn on an even ſurface, ſo as to deceive the eye, and produce in the mind ſimilar effects with the original or real objects.

Of

*Of the Uſe of the three principal * Elementary Planes in the Practice of Drawing—alſo ſhewing that every thing exhibited by the natural Poſitions of theſe Planes in Fig. 2, may be drawn on an even Surface without their Aid.*

It is not always underſtood, even by thoſe who have ſome general notions of perſpective, how it is that theſe planes anſwer to a level ſurface, ſuch as the paper we draw on; but, until there be ſome conception of this, I will venture to ſay that perſpective can never be clearly comprehended. Therefore, that the reader may have a clear view of this matter, I ſhall refer him to Fig. 5, Plate XV. in which are ſhewn ſimilar letters and numerals, correſponding with the ſimilar planes, lines, and points of Fig. 2, as follows:

The plane GOBR, Fig. 5, is the original or ground plane GOBR, Fig. 2; alſo the plane GHLR, Fig. 5, is the perſpec-

* Elementary, " from the Latin *elementum*," the firſt rudiments or principles of any ſcience. Hence, in perſpective, the ground plane, the plane of the picture, and the vaniſhing plane, are conſidered as the three chief elementary planes; becauſe the firſt principles of the art muſt be derived from them. The vertical, directing, and viſual planes, are alſo termed elementary, as has been ſhewn in the firſt ſection, but not ſo eſſential in practice.

tive plane denoted by the ſimilar letters in Fig. 2; and the plane F H L M, Fig. 5, is the vaniſhing plane F H L M, Fig. 2.

If, in Fig. 2, a line be extended from P to *s*, from *s* to Q, and from Q to U, that line will meaſure the length of all the three planes in Fig. 5, as from P to U. Thus the ground plane, the perſpective plane, and vaniſhing plane of Fig. 2, are ſuppoſed to be ſtretched out of their natural poſition till they become an even ſurface, as in Fig. 5. The line G R, in Fig. 5, is therefore the interſection of the picture with its original plane, as in Fig. 2; and the line H L, Fig. 5, is the vaniſhing line, produced by the interſection of the vaniſhing plane with the plane of the picture, Fig. 2. The line F M, Fig. 5, is the parallel of the eye, denoted by theſe letters in Fig. 2. And laſtly, Q *s*, Fig. 5, is the vertical line Q *s*, Fig. 2, which is produced to P, in Fig. 5; on which is placed the diſtance P *s* of the ſpectator's eye from the picture, as P *s*, Fig. 2.

Theſe things being underſtood, proceed to draw the plan of the caſe of drawers on the ground plane G O B R. Thus: from Fig. 2, take the ſpace Q T, equal to the diſtance which the drawers are placed from the picture. Transfer this ſpace to Fig. 5, from Q to *t*, and draw the line 1, 3, parallel to G R; becauſe 1, 3, in Fig. 2, is parallel to the plane of the picture. Ex-

tend the compasses from 1 to 3, and from T to *w*, of Fig. 2, for the length and breadth of the drawers, and make the plan on Fig. 5, the same.

In Fig. 5 produce the line 8, 3, and 2, 1, to G R, at the points 10 and 12, answerable to 10 and 12, Fig. 2, Draw then the visuals 10, *s*, 12, *s*, Fig. 5, corresponding with 10, *s*, 12, *s*, Fig. 2, on the plane of the picture. Take then, from Fig. 2, the perpendicular height T *y* of the drawers, and place this from 10 to *b*, and from 12 to *a*, Fig. 5. Draw then the visuals *b s*, *a s*, answerable to the same letters in Fig. 2. Next, from the points 1, 3, 8, 2, draw lines tending to the point P, which will cut the visual lines at 1, 3, in the same manner as the rays 1, P, 3, P, cut the visuals 10, *s*, 12, *s*, at 1, 3, Fig. 2.

In Fig. 5, from 1, 3, raise the perpendiculars 1, 5, 3, 7, cutting the visuals *b*, *s*, *a*, *s*, at 7, 5, in like manner as the rays 5, P, 7, P, Fig. 2, cut the points 5, 7, on the plane of the picture. Draw then from 7 to 5, Fig. 5, a line parallel to 1, 3, which will determine the height of the drawers; and for the apparent breadth of the top, raise a perpendicular *g*, 6, from *g*, the point where the line 8, P, cuts the visual 10, *s*, and the point 6 will determine the apparent breadth of the drawers; in the same manner as the rays P, 4, P, 6, cutting the visuals *a*, *s*, *b*, *s*,

at the points 6, 4, determine the reprefentation of the top of the drawers 5, 7, 6, 4, at the correfponding points on the plane of the picture, Fig. 2.

By thefe operations it is manifeft that the reprefentation of the drawers in Fig. 5, where the planes are ftretched out till they become an even furface, is the fame in all its parts as the image or reprefentation of the cafe of drawers on the plane of the picture Fig. 2, where all the planes are in their natural pofitions. This would follow from a procefs of geometrical reafoning; but, perhaps, it would be too tedious to the reader, and a deviation from the profeffed plan of this treatife; and, therefore, I fhall only recommend to him, to apply the compaffes to each reprefentation in the different figures, by which he will perceive the equality of parts in both; and, if to this be added a little reflection on the preceding operations, I have not the leaft doubt of its being underftood.

Of the various Poſitions of Lines and Planes to the Picture, and to the Ground Plane—alſo of their Repreſentation on the Picture agreeing therewith, and of their various Modes of Vaniſhing.

THE original line Z X, in Fig. 2, is oblique to the picture, and is therefore treated in a diverſe manner from the lines in the cheſt of drawers, which are all either parallel and perpendicular to the picture, or parallel to the ground plane and perpendicular to it.

Caſe 1.—When any line 1, 3, Fig. 2, is parallel to the picture and to the ground line G R, its repreſentation is parallel alſo. This is ſelf-evident by inſpecting the figure.

Caſe 2.—Lines in the aforeſaid poſitions can have no vaniſhing line or point in the picture, becauſe if infinitely produced would never cut it; that is, the lines 1, 3, and G R, Fig. 2, would never meet in a point, however far produced, for lines truly parallel can never cut each other.

Caſe 3.—The repreſentations of lines originally parallel to each other and to the picture, are parallel to one another on

on the picture. Thus: the lines 1, 3, 5, 7, 4, 6, Fig. 2, are all parallel to each other and to the picture; therefore their reprefentations 1, 3, 5, 7, 4, 6, on the picture, are all parallel to one another, as is felf-evident by comparing thefe with their correfponding lines in Fig. 5.

Cafe 4.—If any original line 1, 5, Fig. 2, be perpendicular to the ground plane, its reprefentation will be perpendicular to the ground line G R; wherefore the reprefentation of the original 3, 7, or any other in the like pofition, fituated any where on the ground plane, is perpendicular to the ground line G R. Hence the correfpondent lines 3, 7, 1, 5, Fig. 5, are drawn perpendicular to G R, the ground line.

From the above theory it may be concluded, that the reprefentation of a geometrical fquare or parallelogram *, is a geometrical fquare or parallelogram, if it be fituated in a plane parallel to the picture. Hence I K, L M, Fig. 6, is the true reprefentation of the original fquare A D, B C, which is in this pofition.

Cafe 5.—All lines perpendicular to the picture, have their vanifhing points in the center of the picture.

* See its definition in page 44, and its figure Plate II.

The

The lines 5, 4, 7, 6, of the ends of the drawers, are perpendicular to the picture H L G R; confequently their reprefentations 5, 4, 7, 6, on the picture, appear to terminate to a point at *s*, the center of the picture. Wherefore, in reprefenting the top of the cheft of drawers at Fig. 5, *b a* is made equal to the length 5, 7, Fig. 2; and from *b a*, Fig. 5, lines are drawn to the center *s*.

Hence the reprefentation of a geometrical fquare, fituated in any plane perpendicular to the picture, is a trapezoid, as I K, L M, Fig. 6; that is, two of its fides, I K, M L, are parallel, and the other two, K L, I M, not fo *.

In whatever pofition an original plane may be in with refpect to the ground plane, if it be but perpendicular to the picture, the reprefentation of a geometrical fquare in that plane will ftill be a trapezoid. If the planes be above or below the horizon, its appearance will be of that figure. Thus, in Fig. 3, *a*, *b*, *o*, *p*, is the reprefentation of a fquare fituated in the ground plane, which is certainly perpendicular to the picture, if the picture be perpendicular to the ground; as N *q*, a fection of the picture, is upright to *q b*, one of the fides of the fquare: *c i* is alfo the reprefentation of a fquare, fituate in a plane raifed above the

* See its definition page 44, and its figure Plate II.

 ground

ground plane, but parallel with it, and therefore perpendicular to the picture in this case; also *ef* is the representation of the same square, situate in the plane of the horizon, which is a plane equal to the height of the eye, as the plane FMHL, Fig. 2. Wherefore in this plane the square does not appear, for it vanishes into one right line, as *e* 2. But if thickness be attributed to the square, as denoted by the double line, then, by the help of shadow, two of its sides may be seen, as *e* 1, 1, 2; but observe, both the sides are in one right line.

The squares *gh*, *lk*, are in planes above the horizon, elevated nearly as much as the other two *ab*, *ci*, are below it; their appearances are therefore trapezoids of nearly the same dimensions. And it is also evident, since all these squares are situate in planes perpendicular to the picture whether above or below the horizon, they must have their vanishing point in the center of the picture *s*; and, as they are all parallel to the ground plane, their common vanishing line will be HL.

Case 6.—If a geometrical square be situated in a plane inclined in any angle to the ground plane, whether it be above or below the horizon, provided the plane be considered perpendicular to the picture, its representation will be, as before, a trapezoid; and likewise its vanishing point will be in the center of the picture. Thus, in Fig. 8, No. 1, ADBC is the representation of a geometrical square in a plane AEPO, inclined to the ground plane

plane equal to the angle *n* A D. Now it is evident, that the ſquare will incline to any angle, by ſuppoſing it to revolve on its center A C in the arch *u n k*; for the ſide D B of the ſquare may be preſſed to *t k* or *o u*, or to any point in theſe arches, without altering its poſition to G R, the ground line or ſection of the picture; therefore, wherever the ſide of the ſquare D B is in theſe arches, it will ſtill vaniſh to *s*, the center of the picture; and its appearance will be a trapezoid: for *u o*, D B, *k t*, are all parallel among themſelves, and to *r s*, which is perpendicular to the picture. For the ſame reaſons the other ſquares above the horizon, though inclined to the ground in different degrees, and in different directions, have the ſame vaniſhing point.

Caſe 7.—All lines oblique to the picture, but parallel to the ground plane, have their vaniſhing points ſomewhere in the horizontal line H L, Fig. 2; but not in the center of the picture, as in Caſe 6, when the line is perpendicular to the picture. Alſo if oblique lines are parallel to each other, they all have the ſame vaniſhing point. The original line Z X, in Fig. 2, is oblique to the picture, and its vaniſhing point is at *v* in the vaniſhing line H L, not at *s*, the center of the picture; for a line drawn from the eye P, and produced till it cut the picture at *v*, in a parallel direction to Z X, is the vaniſhing point of that original line Z X. Wherefore, in Fig. 5, where the elementary planes are ſtretched out to an even ſurface, draw the original

ZX inclined to GR, in the angle which it is ſuppoſed to be in to the picture in Fig. 2. Produce XZ till it cut GR at 14 in Fig. 5; then lay the diſtance of the eye from the picture on the vertical line at P, and from P draw P*v* parallel to ZX; then will *v* be the true vaniſhing point to the line ZX, upon the ſame principles that *v*, in Fig. 2, is the vaniſhing point to ZX in that figure.

If a number of lines oblique to the picture be parallel to each other, they will all have the ſame vaniſhing point; for the ſame reaſon as a number of lines perpendicular to the picture have but one vaniſhing point in the center. Therefore, in Fig. 9, Plate XVI. the geometrical ſquare 1, 2, 3, 4, having its ſides oblique to the picture, the ſides which are parallel to each other are drawn to one vaniſhing point. The ſides *d b*, *c a*, are originally parallel to each other, for they are the repreſentations of 2, 3, 1, 4, of the original ſquare, wherefore they vaniſh into one point at *v*. In like manner, and for the ſame reaſon, the ſides *b a*, *d c*, vaniſh at V. It is evident then, that the repreſentation of a ſquare, having its ſides oblique to the picture, is a trapezium *; that is, none of the ſides are parallel to each other.

* See its figure Plate II. and its definition page 45.

Caſe

Cafe 8.—When a fquare is fituated *in a plane perpendicular* to the ground, but oblique to the picture, *only two of its fides* will vanifh to a point, as BC, AD, No. 2. The other fides, AB, DC, can have no vanifhing point; becaufe they are perpendicular to the ground, and parallel to the picture. See Cafe 2, page 215. Its reprefentation is therefore a trapezoid. And becaufe the fquare is not perpendicular to the picture, its vanifhing point is not in the center *s*, but in fome other point *v* in the horizon, according to the angle which the original fquare makes with the picture, or with its interfection. Thus MA*i* is the angle which the fquare AB, DC, makes with the interfection, or ground line GR; or, in other words, it is the original pofition which the fquare ftands in to the picture. Hence *vd* being parallel to MA, it forms the fame angle to the vanifhing line HL; and being drawn in this direction from the place of the eye *d*, and produced till it cut HL at *v*, confequently *v* is its vanifhing point.

Cafe 9.—If a fquare be fituated in a plane inclined to the ground plane, and its interfection with the picture be parallel to the interfection of the ground plane with the picture, as AF, No. 3, then the vanifhing line of that plane will be parallel to the ground line GR; and two of its fides, AN, FO, may be confidered as perpendicular to the picture; but the other two fides,

ſides, A F, N O, are really parallel, and therefore have no vaniſhing point in the vaniſhing line H L. See Caſe 2, in page 215.

The ſides A N, F O, are conſidered perpendicular to the picture; becauſe, it is evident, that the ſquare may be ſuppoſed to revolve on the ſide A F, and be preſſed or moved to 8, 10; which ſhow the angles of the ſame ſquare in a plane ſtrictly perpendicular to the picture, and therefore its ſides 11, 8, 12, 10, have their vaniſhing point in the center *s*. See Caſe 4, in page 216. Wherefore, as the ſquare may revolve on A F, as a table top hinged at the front, and riſing to any angle from its frame, its vaniſhing point will riſe on the vertical line *s d*, in proportion to that angle. Hence S is the true vaniſhing point of the ſquare A F, N O, making the angle F A 6 with the ground plane.

Caſe 10.—If a ſquare be ſituated in a plane of the above kind, having its ſides oblique to the picture, every thing will be conſidered the ſame as in the foregoing caſe, only the ſides will vaniſh to two points in the horizon; neither of which can be in the center *s*, nor in any part of the vertical line *s d*; becauſe the ſide A B, Fig. 10, of the original ſquare, is not perpendicular to G R. But, as the interſection of this inclined plane with the picture is parallel with the ground plane, as in

Cafe 9, the vanifhing points will rife in a perpendicular direction above the common vanifhing line H L, in proportion to the angle which the inclined plane makes with the ground plane.

Hence *v v* on the new horizontal line *b l*, are placed perpendicular to V V in the common horizon H L; which points V V would be the true vanifhing points of the original fquare A B, B C, were it reprefented upon the ordinary ground plane; or, in other words, if it were reprefented in a plane perpendicular to the picture, and parallel to the ground plane.

Cafe 11.—If a fquare ADBG, Fig. 11, be fituated in a plane oblique both to the ground plane and to the picture, its vanifhing line will be in an angle to the common horizon H L, in proportion to the angle which the inclined plane makes with the ground. For, as the original plane in this cafe is inclined both to the ground and to the picture, confequently its interfection with the picture will be oblique to the interfection of the ground plane with the picture. Cafe 9 has a horizontal vanifhing line, though it fuppofes the original plane to be inclined to the ground; but as its interfection is parallel to the ground line, fo its vanifhing line is parallel alfo. In the cafe before us, the original plane has an oblique interfection with

the

the picture, and therefore its vanishing line is oblique to the horizon also; which, perhaps, may be better understood by No. 1, showing the same square in the same position, considered as the top of a table viewed angle-ways, whose top is supposed to be rising on its hinges at A C in the angle *u* A K. Its vanishing line is therefore *v* V, found by drawing M V, making an angle with the horizontal line H L, equal *u* A K, the angle which the inclined plane makes with the ground. Or the vanishing line may be found as in Fig. 11; by drawing *v* M, cutting O *m*, which is a line perpendicular to the horizon; from the measuring point *m*, draw M V parallel to the horizon, cutting V P at V; then will the line *v* V be the true vanishing line as before. The line A X is considered as the intersection of the inclined plane, and is therefore drawn parallel to *v* V, the vanishing line; for, in perspective, it is a universal theorem, according to Dr. Brook Taylor's system, that the vanishing line, intersection, and directing line of any original plane, are parallel to each other; also, " the vanishing points of all lines in any original plane, are in the vanishing line of that plane." See his Sixth and Seventh Theorems. Wherefore the line A X is to *v* V the vanishing line, the same as the ground line G R is to the horizontal line H L.

These, and the other lines which I have hitherto passed

over

over unnoticed in the various cafes, will be explained in the different problems belonging to each particular cafe, and therefore I deem it unneceffary to fay more on them at prefent.

SECTION III.

Containing Problems in Perfpective, folved according to the preceding Principles and Cafes—applied to the Methods of drawing rectangular Superficies and Solids in different Pofitions to the Picture.—Alfo, how to draw Vifual Lines, tending to vanifhing Points, out of the Picture; and how to reduce the Point of Diftance to any Proportion, fo as to bring it within the Limits of the Picture.

In the methods of inftruction generally made ufe of by moft of thofe who have written on this fubject, it is common for them to begin with finding the reprefentations of points and lines, proceeding afterwards to fuperficies and folids.

To me, however, it appears an unneceffary prolixity, efpecially it would be fo to the perfons for whom this treatife is chiefly intended. For to go through all the problems neceffary for points and lines as they may be differently fituated to the ground plane and picture, and alfo to fhow how thefe lines are to be meafured off according to any given length, would take

 up

up as many plates and pages of letter-prefs as would be fuffi-cient to explain the fuperficies of figures of which thefe lines are the boundaries.

Befides, it is prefumed that the general readers of this work will underftand the various pofitions of lines, and how to meafure them off, according to their given lengths, better when they are connected with fome figure, than when thefe fame lines are confidered abftractedly. And, in general, it may be faid, that when perfons fet about drawing, it is not to reprefent a line or a point nakedly, but to draw the perfpective appearance of fome figure bounded by lines and points; which, when performed, muft of courfe include every thing requifite to the reprefenting or meafuring of a bare line. Therefore, in finding the reprefentation of a geometrical fquare, for inftance, the problem for this will teach us both how to find the points of its angles, and at the fame time how to reprefent and meafure a line equal to the fides of the given fquare, or any other figure of that nature. For thefe reafons I omit points and lines, and proceed to the firft problem, which is

PROB.

PROB. I. FIG. 7. Plate XV.

To represent a Geometrical Square lying on the Ground, having two of its Sides parallel to the Picture, and the other two perpendicular to it.

OPERATION.—Draw the ground line G R, and draw H L for the vanishing line, whose height from the ground line is supposed to be equal to the height of the spectator's eye. Make *s* the center, or that point in the picture which is directly opposite to the eye when the picture is viewed. Make *d* the distance of the eye from the picture, answering to P *s*, in Fig. 2, Plate XIV. In this manner the paper or canvass we draw on is prepared for delineating objects in the above situation.

The next thing to be considered, is the seat of the object in the picture; that is, how far the square, for instance, is to be placed to the right or left of the center *s*, or whether it is to be directly under the center, and how far removed back from the picture. These being fixed on, lay down C A equal to the side of the square to be represented, and draw the lines C *s*, A *s*, termed visual lines. Determine then how far the square is to be removed from the picture, which in this example is equal 1 2.

Draw from 2 a line to the point of diſtance *d*, cutting the viſuals C *s*, A *s*, at B and A. Laſtly, from theſe points of interſection at B and A, draw the lines A C, B I, parallel to G R, the ground line, and the repreſentation will be completed as required.

Obſervations.—The ſides C B, A I, of the ſquare, are perpendicular to the picture, and therefore, by Caſe 5, page 216; they muſt vaniſh in *s*, the center of the picture. The ſides C A, B I, are conſequently parallel to G R, the interſection of the picture or ground line; wherefore, by Caſe 1, page 215, they are the repreſentations of original lines parallel to the picture; and being parallel, they can have no vaniſhing point.

Prob. II. Fig. 7. Plate XV.

To find the Repreſentation of a Square perpendicular to the Ground, and alſo to the Picture.

The picture being already prepared in the foregoing problem, the ground line and vaniſhing line remain the ſame; alſo the point of diſtance and the center *s* are the ſame. And it ſhould be obſerved, that G R is the ground line, and H L the horizontal line in every example. Alſo *s* denotes the center of the

the picture, and d the distance; therefore, in future, the explanation of these may be omitted, and we may proceed as follows:

Operation.—Draw the perpendicular A D equal to the sides of the original square, and draw the visuals D s, A s. Then, on the ground line G R, lay on a space from 1 to C equal to the distance of the square from the front of the picture. Make C N equal A D, and draw C d, N d, cutting the visual A s in I and M. Lastly, from I and M raise perpendiculars to K L, and the square will be represented as required.

Observations.—The sides I K, M L, are perpendicular to the ground; wherefore, according to Case 4, page 216, they are the representations of lines originally perpendicular, as A D; and being perpendicular to the ground, consequently they are parallel to the picture, and therefore can have no vanishing point. But the sides K L, I M, are perpendicular to the picture; therefore they vanish to s, the center.

PROB. III. FIG. 6. Plate XV.

To repreſent a Square ſtanding upright on the Ground, but parallel to the Picture.

THE ground line and horizontal line, &c. remaining as in the preceding problem, proceed to the operation. Draw A D B C a geometrical ſquare on the ground line. Draw the viſuals A *s*, D *s*, B *s*, C *s*; then lay on a ſpace A N on the ground line equal to the diſtance which the ſquare is ſuppoſed to be from the picture. Draw N *d* cutting the viſual A *s* in I. From I draw I M parallel to A C. Draw I K, L M, perpendicular to A D, C B. And, laſtly, draw K L parallel to D B; then will the ſquare I K, L M, be the repreſentation of the original ſquare A D B C, as propoſed.

Obſervations.—The viſual rays A *s*, D *s*, B *s*, C *s*, form a pyramid*, whoſe baſe is a geometrical ſquare A D B C, and whoſe vertex is *s*, the center of the picture. If this pyramid have a ſection parallel to its baſe, it muſt be evident to every one, that the ſection will produce a geometrical ſquare. The

* See its definition page 97, and its figure Plate VI.

repreſentation

representation IKLM is a parallel section of the pyramid of rays issuing from each angle of the original square ADBC, and therefore IKLM, the section, is a geometrical square. See the conclusion drawn from Case 4, page 216, in which we say,—"That the representation of a geometrical square or parallelogram is a geometrical square or parallelogram, if it be situated in a plane parallel to the picture."

PROB. IV. FIG. 8. Plate XV.

To represent a Square situated in a Plane inclined to the Ground, and perpendicular to the Picture..

AOPE may represent the inclined plane, which is merely to assist the imagination, or to convey what is to be understood by the square ADBC, No. 1. being in a plane inclined to the ground.

Operation.—On GR, the ground line, draw the semicircle *u n k*, whose radius must be equal to the side of the original square. Draw *n* A perpendicular to the ground line; then make *n* A D equal to the angle of inclination which the original square has to the ground. Draw then, as before, the visuals A *s*, D *s*, to the center *s*. Let *d*, near L, on the common horizontal line

H L, be the diſtance as in common; draw the line *u d* cutting the viſual line A *s* in C. From C draw C B parallel to A D, then will A D C B be the repreſentation of a geometrical ſquare, ſituated in a plane inclined to the ground, in an angle of twenty-three degrees.

Method ſecond.—Let G 1, R 1, be the interſection of the inclined plane with the picture; or, in other words, let it be conſidered as a new ground line, and turn the plate till this line come into the ſame ſituation with the eye as the old ground line G R appeared to be in when the plate was upright. This will make every thing in this ſecond method appear quite plain, I preſume, and will ſhow that it is as eaſy to repreſent a ſquare in a plane inclined in any degree to the ground, if it be perpendicular to the picture, as it is to repreſent one lying on the ground, having two of its ſides perpendicular to the picture. The plate being placed to the eye as above mentioned, draw a new horizontal line *h i*, *l i*, parallel with G 1, R 1, paſſing through the center *s*. Make *s d* on this new horizontal line equal *s d* on the old one H L. From D lay down the ſide of the ſquare D A, and draw the viſuals A *s* and D *s*. From A draw A *d*, cutting the viſual D *s* in B. Make B C parallel to A D, and the repreſentation will be as before. In No. 2 the ſame ſquare is inclined to the other hand; but the operation is ſtill the ſame, when the new ground line G 2, R 2, is drawn, and when a new horizon

horizon, *b* 2, *l* 2, is drawn parallel to it, paſſing through the center *s*, *d* near *b* 2 will then be its diſtance, or *d* near *l* 2 will do, for they are both the ſame to the ſquare No. 2; ſince both the diagonals of the ſquare, if produced, will tend to each point of diſtance, as is evident from inſpection. The ſquares No. 3 and No. 4 are repreſented above the horizon; but as they are conſidered in planes perpendicular to the picture, this makes no difference in their repreſentations, for their perpendicular ſides vaniſh in *s*, the center, and the operation is the ſame above as below the horizon in all reſpects. As I have marked the ground lines and vaniſhing lines to each ſquare, diſtinguiſhing them by the ſame numeral that the ſquares are marked with, I think it unneceſſary to go through the operations, as it would only be repeating what has been ſaid on thoſe below the horizon. See Caſe 6, on Fig. 8, No. 1, in page 219.

Obſervations.—From what has been ſaid on Fig. 8, it is evident that the foregoing problem may be applied to uſeful purpoſes in repreſenting different pieces of furniture; and that which has been frequently done at random, for want of knowing better, may be done with great eaſe and accuracy. For inſtance, the riſing deſks of the library table, Plate XXX, are repreſented by this problem. The two ſemicircles ſhew that the deſk, raiſed to any pitch, will ſtill be within theſe arches,

which are the boundaries of the defk, as it paffes round on its hinges.

PROB. V. FIG. 9. Plate XVI.

To reprefent a Square fituated in a Plane inclined to the Ground and to the Picture, when the Interfection of the inclining Plane is parallel to the Ground Line, or when its Interfection is in the Interfection of the Ground Plane with the Picture.

IN this cafe the common ground line GR is the interfection of the inclined plane with the picture; and a line, SP, produced parallel to GR will be the vanifhing line of this plane.

Operation.—Let HL, the common horizon, be drawn as ufual; and let *s* be the center of the picture. From *s* to *p* is the diftance of the eye from the picture. Take in the compaffes, AF, equal to the fide of the fquare, and with it fweep the arch *q r* from *p*; then from *r* to *q*, on the arch *q r*, lay on the degree of inclination which the original plane has to the ground; and draw *p q* produced till it cut the vertical line *s d* in S; then will S be the vanifhing point of the fquare in the in-

clining plane, for the fame reafon as *s* is of the fquare 11, 12, 10, 8, on the level ground. Make S P equal to *sp*, and P will be the point of diftance to the inclined plane. Draw the vifuals A S, F S, and from A draw A P, cutting the vifual F S in O. Laftly, draw O N parallel to A F, and the reprefentation of the fquare will be found as propofed. See Cafe 9, page 221.

Obfervations.—The vifuals A S, F S, may be cut by another method to the fame effect. Thus: draw the line 5 6 parallel to S *p*, and take the fide of the original fquare and place it from A to 5. Draw from 5 a line to *p*, the diftance on H L, and it will cut at N, as before. The truth of this will appear by comparing No. 1 with No. 3. At No. 1 draw G R for a ground line, and perpendicular to it draw A *s*, a fection of the picture. Lay on, from A to *s*, No. 1, the height of the common horizon; that is, from A to *s* on the perpendicular line A B *s*, Fig. 9. From *s*, the center of the picture at No. 1, draw *s p* equal *s p* the diftance at Fig. 9. Make A N, the inclined plane, of equal angle to *q p r*, the angle which the original plane makes with the ground. From A to N, No. 1, lay on A F equal to fide of the fquare No. 3. Lay the fame from A to G, No. 1. Laftly, draw G *p*, N *p*, cutting the picture at *n* and 8. Take, in the compaffes, the fpace from A to *n* at No. 1, and lay it from 9 to N at No. 3, and it will be feen that they are equal. In the fame manner take A 8 at No. 1, and lay it from 9 to 8 at No. 3, and

 it

it will be found that they are equal. This fully demonſtrates the truth of the repreſentation of the ſquare A F, N O; for, beyond all diſpute, *n*, at No. 1, ſhows how much the ſquare on the inclined plane riſes on the picture; and 8, at No. 1, as certainly ſhows how much the ſame ſquare lying on the level ground riſes; and ſince they both coincide with their repreſentations at No. 3, there can remain no doubt but S is the true vaniſhing point, and P the true point of diſtance.

N. B. This problem is of uſe to repreſent any table top hinged at the front, and riſing by a horſe behind to any pitch.

Prob. VI. Fig. 9. Plate XVI.

To find the Repreſentation of a Square lying on the Ground, having its Sides oblique to the Picture.

Operation.—Draw the plan of the ſquare propoſed, as 1, 2, 3, 4, in any angle to the ground line G R, as may be required. Produce the ſide 1 4 till it cut the ground line at *k*. Alſo produce the ſide 1, 2 till it cut at 1 4. Let *s* be the center of the picture as uſual, and draw *s d* perpendicular to H L. Let *d* be the diſtance of the eye from the picture. From *d*, draw *d* V parallel

rallel to 1, 2, one of the ſides of the ſquare. From *d*, draw *d v* at right angles to *d* V, then will V *v* be the true vaniſhing points of the ſides of the ſquare; for the line *d* V is parallel to the ſide 1 2, and *d v* is parallel to 1, 4; wherefore *v* V are the true vaniſhing points. Hence, from 1 4, and from 3, draw right lines to V, and from *k* and 3 draw lines to *v*; and where theſe lines cut each other at *d*, *b*, *a*, *c*, will be the repreſentation of the original ſquare 1, 2, 3, 4, as required.

Method ſecond.—To draw the ſame ſquare without the trouble of a ground plane.

Operation.—Every thing remaining as before, extend the compaſſes from *v* to *d*, and lay *v d* to *m* on the horizon; then will *m* be the meaſuring point to the viſuals 3, *v*, *k*, *v*. Make *d* 13 on the ground line equal to the ſide of the ſquare. From 13 draw a line to *m*, cutting the viſual 3 *v* at *b*. From *b* draw *b* V, cutting at *a*, as by the firſt method.

The angle of the original ſquare being brought into the picture at 3, a line from 3 to V finds the other ſide *d c*, without any further trouble.

Obſervations.—The truth of this problem will appear from what has been ſaid in Caſe 7, p. 219, which I would adviſe the reader

reader to examine. And I would further remark, that if viſual rays be drawn from each angle of the original ſquare 1, 2, 3, 4, to the vertical line *s d*, they will cut at *b*, *a*, *c*, as in the preceding methods. The rays from Z X to P, in Plate XIV. Fig. 2, are the ſame to the original Z X, as the rays 1 *d*, 4 *d*, are to the ſide of the ſquare 1, 4, in the figure before us. For *c a*, in this figure, is the repreſentation of 1, 4—and *z*, *x*, on the picture in Fig 2, Plate XIV. is the repreſentation of Z X.

Prob. VII. Fig. 9. Plate XVI.

To find the Repreſentation of a Square ſuppoſed to be ſituated in a a Plane perpendicular to the Ground, but oblique to the Picture.

For this problem, the picture being completely prepared as for the preceding one, the operation will be extremely conciſe, as follows:

Operation.—Raiſe a perpendicular line A B, No. 2. On the perpendicular A B lay the ſide of the ſquare from A to B. From B and A draw viſual lines to *v*, the vaniſhing point; found as before. From A, lay down the ſide of the ſquare to *i*; and from *i* draw *i m*, cutting the viſual line A *v* in D. Laſtly, draw D C parallel

parallel to A B, and the repreſentation will be found as required. See remarks in Caſe 8, page 221.

PROB. VIII. FIG. 10. Plate XVI.

To find the Repreſentation of a Square having its Sides oblique to the Picture, ſuppoſed to be in a Plane inclined to the Ground, as in Problem V.

OBSERVATIONS.—This problem differs in no reſpect from the fifth, except what relates to the ſquares repreſented in theſe inclined planes. In the fifth problem, the ſquare in that inclined plane, having two of its ſides parallel to the picture, the others of courſe vaniſh in S, perpendicular to *s*, the center of the picture. In this problem the ſquare repreſented in the inclined plane has its ſides oblique to the picture, and therefore they vaniſh to two points in ſome new vaniſhing line, *b l*, parallel to the common one H L; becauſe the interſection of the inclined plane is parallel to the ground line.

Operation.—Draw, as uſual, G R the ground line, and H L the horizon. Let *s* be the center, and *d* the diſtance of the picture. Draw A B, one ſide of the original ſquare; make

make *d* V parallel to A B, the ſide of the ſquare; and draw *d*, V L, at right angles with *d*V, then will V, V L, be the vaniſhing points of the ſquare 4, *p*, 5, 6, on the level ground. Make V M equal V *d*, and L V *m* equal L V *d*; then will *m* and M be the meaſuring points of the viſuals tending to V, V L. Thus far the picture is prepared only to repreſent the ſquare on the level ground; therefore we muſt proceed to find the vaniſhing line, points, and meaſuring points, of the inclined plane, thus:—Draw perpendiculars at pleaſure from V, and V L. From M draw M *v*, in an angle to V M equal to the angle which the inclined plane makes with the ground. Through *v* draw *b l* parallel to H L, cutting the perpendiculars V *v* at *v*; then will *v v* be the vaniſhing points ſought. Make *v n* equal *v* M, and *n* will be the meaſuring point ſought. Draw then the viſuals 4 *v* and 4 *v l*. Make 4, *o*, 4, *r*, equal to the ſides of the original ſquare B A. From *o* draw *o n*, cutting at 1; and from *r* draw *r p*, cutting at 3. From 3 draw 3 *v*, and from 1 draw *i v l*, interſecting at 2; then will 1, 2, 3, 4, be the repreſentation of the ſquare propoſed.

Obſervations.—The line *t* B paſſes through the diagonal of the original ſquare, whoſe ſide is A B. Draw from *d*, the diſtance, a line parallel to B *t*, cutting at *g* on the common horizon. From 4 draw a line to *g*, and it will paſs through the diagonal of the

ſquare

ſquare 4 *p*, 5, 6, lying on the level ground. Draw from *g*, a perpendicular to *g* on the new horizon *b l*. From 4 draw a line to the uppermoſt *g*, and the line will paſs through the diagonal of the ſquare repreſented on the inclined plane; which is a clear demonſtration of the truth of the whole.

The truth of the method may be proved, alſo, by drawing a line from A to D, the diſtance laid on from the new horizon *b l*; for the line cuts the viſual at 1, as in the other method.

PROB. IX. FIG. 11. Plate XVII.

To find the Repreſentation of a Square, ſituated in a Plane oblique both to the Ground and to the Picture.

THIS figure may, to the workman, appear intricate and perplexed; but he ought not to be diſcouraged at the ſight of an aſſemblage of lines, till, after having made a reaſonable attempt to underſtand them, he finds it not eaſily attained. But it is to be noticed, that there are ſeveral more lines than what are abſolutely neceſſary for repreſenting the ſquare ſimply conſidered; becauſe I have ſhown different methods to effect the ſame thing; and becauſe the whole proceſs is ſhown from firſt to laſt, that the reader might have a clear

underſtanding of a problem really uſeful, but rarely known amongſt workmen, and even not amongſt painters.

Operation.—Draw G R, the ground line, and H L, the horizon, as uſual; and make *s* the center of the picture. Draw *s d* perpendicular to H L; and let *d* be the diſtance of the picture. Make the angle *d v s* equal to the angle which the ſquare in the inclined plane makes with the picture; and draw *d* P at right angles to *d v*; and make *v m* on H L equal *v d*. Draw at pleaſure *m* M *o* perpendicular to the horizon. Make *v* M to incline in an angle equal to that which the original plane makes with the ground. Draw M, V *x* parallel to the horizon; and from V *x*, draw V *x*, *v*, which will be the vaniſhing line of the inclined plane. From the center *s*, draw *s* S, *d x* perpendicular to the vaniſhing line *v*, V *x*. From *s*, draw a line to *d* 1, parallel to *v* S V *x*. Extend the compaſſes from S to *d* 1, and make S, *d x*, equal to S, *d* 1; then will S, *d x* be the diſtance of the picture for the inclined plane. Make V *x*, *m* 2, equal V *x*, *d x*, and *m* 2 will be the meaſuring point.

The picture being thus prepared for delineating the ſquare, draw from A, the viſual A *v*; and from A, the viſual A, V *x*. Draw A X parallel to the vaniſhing line *v*, S V *x*. Lay on, from A to *w*, a ſpace equal to the ſide of the ſquare; and from *w*, draw *w*, *m* 2, cutting at D. From D, draw a line to *v*, for the ſide

8 of

of the ſquare D B. Make alſo A N equal to the ſide of the ſquare; and draw N *m*, cutting at G; and laſtly, draw G V *x*, cutting at B; and the ſquare will be completed as required.

Method ſecond.—From A, ſweep the arch *k* K, whoſe radius is equal to the ſide of the ſquare to be repreſented. Draw A *u* equal to the angle of the inclined plane with the ground; and from *u*, draw *u t* parallel to the ground line; from *t* draw a viſual to P; and from *u*, draw *u* M, cutting at D; from A draw a line through the interſection of *u* M with *t* P, and produce this line till it find the vaniſhing point V *x* in the perpendicular P V. From D draw a line to *v*, as before; and laſtly, from G, found as before, draw G V *x*, cutting at B, and the ſquare will be completed, as in the other method.

Obſervations.—If the original plane inclined to the ground in an angle of forty-five degrees, the viſual line of the ſide of the ſquare A D would paſs through the diagonal of the ſquare A, *k*, *n*, 8, and tend to the upper V, the vaniſhing point in that caſe; and V *v* would then be the vaniſhing line, S would be the center of the picture, *m* the meaſuring point, and *d* 3 its diſtance, and *v*, *d* 3, Q would be the angle of the inclined plane, which is the diagonal of a ſquare *v*, *d* 3, Q, *m*. It is evident then, that the true repreſentation of a ſquare in any inclination, would

deſcribe a quadrant of a circle, whoſe radius would be the ſide of the ſquare repreſented, as the figure ſhows.

N. B. No. 1 is the ſame problem, diveſted of all lines but ſuch as are abſolutely neceſſary to its repreſentation; which, it is preſumed, will be readily underſtood by inſpection, after what has been ſaid on Fig. 11. See page 224.

PROB. X. FIG. 12. Plate XVIII.

To repreſent a Floor of Squares parallel to the Picture.

G R is the ground line, and H L the horizon.

Let *s* be the center, and *d* the diſtance of the picture.

Let it now be required to repreſent thirty-ſix ſquares.

Operation.—Lay A D, the ſide of the original ſquare, ſix times on the ground line G R, contained between A *b*, as the figure ſhows. Draw from each diviſion on the ground line viſuals to *s*; and from *b*, draw a line to *d*, the diſtance; which line will cut each viſual in *i*, *k*, *l*, *p*, *q*, *r*. Through the

ſeveral

ſeveral points of interſection marked by theſe letters, draw lines parallel to G R, the ground line, and there will be produced the number of ſquares required. But if it be neceſſary to fill up the picture with theſe ſquares, and there be no room for laying A D on the ground line beyond *b*, then continue the laſt parallel line *r o a b c* the whole extent of the picture; and take *o a* equal to the ſide of the ſquare, and repeat it *a*, *b*, *c*, as may be neceſſary. From *s*, draw *s b*, produced forward to the ground line. In the ſame manner draw *s c* forward, and ſo on repeatedly. Then, laſtly, draw parallel lines from the former ſquares, by which means the picture will be filled up to the ſides.

Obſervations.—The diagonal line *b d* paſſes through the oppoſite angles of the large ſquare A, *r*, *a*, *b*, which includes all the other; and a line through the oppoſite angles of any of the ſmall ſquares, will alſo tend to the ſame point of diſtance *d*.

Of the Repreſentation of Rectangular Solids in different Poſitions to the Picture.

Prob. XI. Fig. 12. Plate XVIII.

To repreſent a Row of Cubes, or a Priſm, parallel to the Picture.

Operation.—The ground line, horizon, &c. remaining the ſame as for the floor of ſquares, draw A, B, C, D, a geometrical ſquare, equal to one ſide of the cube. Draw the viſuals A *s*, B *s*, C *s*, D *s*. From D, draw D *d*, cutting at 1. Draw 1, 2, parallel to the ground line, cutting D *s* at 2. From 2 raiſe a perpendicular, cutting C *s* in 5; from 1 raiſe a perpendicular to 4, cutting B *s* in 4. Laſtly, from 4 draw a line to 5, parallel to the ground line, or to BC; and the repreſentation of the firſt cube will be completed. Next, from 2 draw 2 *d*, cutting at 3; draw 3, 8, cutting D *s* in 8; from 8 draw 8 *d*, and it will find the baſe of the ſecond cube; and repeating every thing as in the firſt cube, any number of them may be drawn till they vaniſh in the point *s*.

Obſervations.—If a number of cubes, or priſms, are to be repreſented in various places on the picture, it will be done with

with the moſt eaſe, firſt, to repreſent a floor of ſquares equal to the ſide of the cubes, or baſe of the priſms. Thus, for inſtance, the priſm *r* is eaſily delineated on the back part of the picture, by raiſing a perpendicular M N equal to the original height of the priſm. Draw N *s*, and from any ſquare where it is to ſtand, raiſe perpendiculars cutting N *s* at *r*. From *r* draw a line parallel to the ground line, which will complete the priſm. In like manner the cube *k i* may be repreſented any where.

Laſtly, we may ſee, in the repreſentation of a cube, that it conſiſts of three different caſes of geometrical ſquares; that is, A, D, 1, 2, is the repreſentation of a ſquare lying on the ground; and 1, 4, 5, 2, is the repreſentation of a ſquare perpendicular to the ground, and parallel to the picture: and D, C, 5, 2, is a ſquare repreſented both perpendicular to the ground and to the picture. The other three ſides of the cube are reſpectively parallel to thoſe we have mentioned, and therefore are the ſame in all reſpects.

PROB.

PROB. XII. FIG. 13. Plate XVIII.

To repreſent two Rows of Cubes oblique to the Picture.

OPERATION.—G R is the ground line, and H L the horizon. Let *s* be the center of the picture, and *s d* the diſtance. From *d*, draw *d*V, cutting H L in V, and parallel to that ſide of the original cube; whoſe repreſentation is A B C *g*. Draw *dv* at right angles with *d*V, cutting at *v*; then will *v* be the vaniſhing point of the right hand ſide of the ſquare. Make V M equal V *d*, and *v m* equal *v d*; then will M *m* be the meaſuring points. From A, the angle of the firſt cube, draw the viſual A *v*. Draw alſo A V. Make A B equal to the ſide of the cube, and from B draw B V, B *v*. Next, lay A B to 7, and from 7 draw a line to the meaſuring point *m*, cutting at *a*. Lay A B to *c*; and from *c* draw *c* M, cutting at *g*; from *g* and *a* raiſe perpendiculars to C and D; from D draw a line to V, and from C to *v*, which will complete the repreſentation of the firſt cube.

The ſpace between the cubes being conſidered equal to the ſide of the ſquare, repeat A 7 each way on the ground line, as often as there is room, as at 8, 9—*d*, *e*, *f*. From each of theſe diviſions

divifions draw lines to their refpective meafuring points *m* M, cutting A *v* in *b* and in 2, and AV in *b i k*. Raife perpendiculars from *b* and 2, cutting the upper vifuals. Do the fame from the other points *b i k*, and proceed in all refpects as with the firft cube, and there will be two more produced.

Obfervations.—If it were required to reprefent two additional cubes to each row, it is evident that we muft have recourfe to fome expedient for this purpofe; becaufe there is not room beyond 9 and *f* to lay on any more divifions. Therefore from 2 produce a line parallel to the ground line, and from *k* do the fame. And obferve, that a line from 8 to *m*, and from *e* to M, cut thefe parallel lines at *n* and 1. Extend the compaffes from 1 to 2, and repeat this at 3, 4, 5, 6, and from thefe divifions draw lines to *m*, and they will cut the vifual A *v* in the fame points in which it would have been cut if thefe lines had been drawn from the original divifions on the ground line. Laftly, a line from *e* to M will cut the left hand parallel at *n*; repeat *n k* at *p q r*, and proceed as before. By this method, which is quite fimple, it is evident we may draw as many cubes as we pleafe, by adding parallel lines to the ground line.

Of drawing Viſual Lines tending to Vaniſhing Points out of the Picture.

In the practice of drawing it is frequently found, by experience, that if we make uſe of a ſhort diſtance, the figure we repreſent will appear diſtorted and unnatural; and when we, to avoid this, make uſe of a long diſtance, it will perhaps exceed the paper or picture we draw on; alſo, in the repreſentation of objects obliquely ſituated to the picture, their vaniſhing points not being in the center, it often follows, as the conſequence of chooſing a long diſtance, that the vaniſhing points far exceed the limits of the picture. To alleviate theſe difficulties, we propoſe the following problem.

Prob. XIII. Fig. 14. Plate XVIII.

To repreſent two upright Priſms obliquely ſituated, whoſe Diſtance and Vaniſhing Points exceed the Limits of the Picture.

Let the double line on each ſide of Fig. 14 be conſidered as the boundaries of the picture. Draw, as uſual, the ground line G R, and the vaniſhing line H L, and make *s* the center of

 the

the picture. Let $s\ d$ be conſidered as only half the diſtance, becauſe there is no more ſpace in the picture above d. From the point d, draw a right line each way, at a diſtance from s, equal $s\ d$, forming a right angle; becauſe the ſides of the priſms are originally perpendicular, to each other. Make $v\ m$ equal $v\ d$; then would m be the true meaſuring point, provided $s\ d$ were the whole diſtance of the picture; and in this caſe $v\ v$ would be the vaniſhing points of the ſides of the priſms; but ſince $s\ d$ is only half the real diſtance, take in the compaſſes $s\ m$, and repeat that ſpace to M, and make s M, s M, equal, then will M M be the true meaſuring points to the whole diſtance. Produce the vertical line $d\ s$ to A, cutting the ground line at A. Divide $s\ d$ into any number of equal parts, as 1, 2, 3, 4, and, for the ſake of accuracy, ſubdivide theſe as in the figure. Lay on the ſame diviſions downwards from s to A.

The next thing to be conſidered, is to draw a line perpendicular to the horizon, of ſuch a proportion to $s\ d$, at any given diſtance from s, the center, according to the boundaries of the picture, that when a line is drawn from d, touching the top of the ſaid perpendicular, it would exactly tend to the true vaniſhing point, were it produced to the horizontal line. We ſhall ſuppoſe then, that a perpendicular line is drawn from the point v, which is exactly half the diſtance from s the center to V the vaniſhing

point out of the picture. Make then the said perpendicular line *v* 4, half the length of *s d*; then a line passing from *d* to 4 would, if produced, terminate at V, the true vanishing point. Divide *v*, 4 in the same manner as *s d*, and downwards from *v* to 3 lay on the same divisions; for *v* 3 is half the length of *s*·A. Lastly, make the other scale on the left in the same proportion, then will the picture be properly prepared for delineating the proposed prisms.

Operation.—From A draw a line to 3, which will be the visual for the bottoms of the prisms, for A 3 produced would tend to V. Make A *c* equal to the distance which the prism is supposed to be from the picture; then, from *c*, draw a line to M, cutting at *p*; from *p* lay a ruler across the two scale lines, and move the ruler backward and forward till its edge coincide with *p*, and any correspondent division on each scale. The ruler being thus fixed, draw a line *p b*, cutting the scale line *s* A in the second division, and the scale line *v* 3 to the left in the same division; then would *p b* produced terminate in a point on the horizon equally distant from *s* as V is. Make A *a* equal to the left side of the prism, and draw *a* M, cutting at *b*. Make *c e* equal A *a*; and from *c* draw a line to M, cutting at *b*. From the points *p*, *b*, *b*, raise perpendiculars at pleasure.

Consider

Confider now the height of the prifm, which we fuppofe to be AB; from B place the edge of the ruler, and move it till it be at fimilar divifions on each fcale line, as before. The ruler being in this pofition, draw a line cutting the perpendicular *p* D at D; and from D, place the ruler till it coincide with fimilar divifions on each fcale line on the left, which will complete the reprefentation of the firft prifm; and for the fecond, proceed in the fame way, obferving that, as there is not room on the ground line GR for repeating the fide of the prifm *c e*, the fcale line, or new ground line *b i k*, muft be found, as in the preceding problem, by drawing through *b* a line parallel to the old ground line, cutting at *g*, then muft the fpace *b g* be laid to *i* and *k*, from which lines being directed to M, they will cut at *l o*.

Obfervations.—In Problem XXI. page 71, Plate II. Fig. 15, the geometrical principle is explained, upon which this method of drawing vifuals to points out of the picture is founded.

We there fay, in page 72, "In whatever proportion the extreme line EP is divided, into the fame proportion will the hypothenufe line EO be divided." Agreeably to which, we may obferve in the perfpective problem before us, that, in whatever proportion the diftance *s d* is divided, a line being drawn from the faid divifion parallel to the horizon, will cut

the

the viſual *d* V in that ſame proportion. The line *s d* being divided into two equal parts, a line from 2, parallel to the horizon, will cut at 4, which divides the viſual *d* V into two equal parts; and a line from the point 4, perpendicular to the horizon, will divide *s* V in the ſame manner. Hence it is evident, that if *s d*, *v* 4, be divided into the ſame number of equal parts, a line drawn through any two correſpondent diviſions, will tend to V, the vaniſhing point. It is alſo evident, by the ſame mode of reaſoning, that if the half diſtance *s d* were produced to twice its preſent length, which would then be the whole diſtance, a line from *d* to V would be equal to the ſpace from V to M, on the left the true meaſuring point, in the ſame manner as *d v* meaſures *v m*, which is only half that ſpace.

Of reducing the Point of Diſtance, ſo as to bring it within the Limits of the Picture.

In making deſigns on a large ſcale, it is very common for the point of diſtance to exceed the bounds of the paper or board we draw on: to avoid the inconvenience of which, let the following problem be attended to.

Prob.

Prob. XIV. Fig. 15. Plate XVIII.

To find the Repreſentation of a Number of Squares when the Diſtance is out of the Limits of the Picture.

The double lines which include the ſquares, are the boundaries of the paper, board, or picture we draw on.

Operation.—Let *s* be the center, and let *s d* be ſuppoſed half the length of the point of diſtance. Make then a ſcale on the ground line, whoſe equal parts ſhall be equal to half the ſide of the ſquares to be repreſented, as 3, 4, 5. Lay on from 3 to 4 half the ſide of the ſquare A, and from 4 draw a line to *d*, half the diſtance, which will cut the viſual 3 *s* in the ſame point as it would have been cut if *d* had been twice its preſent diſtance from *s*, and the whole ſide of the ſquare had been laid on the ground line, as at 5; for it is evident, that a line from 5 through *t* would terminate in a point on the horizon twice the diſtance of *s d*. From 4 lay on 5, 6, equal 3, 4, and drawing lines to *d*, we ſhall have the ſquares B C. Here the learner muſt obſerve another difficulty ariſing; for the ground line of the picture is filled up at 6, and we are ſuppoſed to want the repreſentation of three more ſquares; and as the point 6 is near the extremities

of

of the picture or board we draw on, there can be no opportunity to lay on the fides of the fquare any further; we muft again therefore reduce the length of the point of diftance to *b*, which is only one fourth of the whole diftance; in proportion to which we muft alfo reduce the fcale on the ground line to one fourth of the fide of the fquare, as 1, 2; or, which is the fame thing, divide the fpace 5, 6, into two equal parts, and from 6, *o*, 5 draw lines to *b*, and three more fquares will be cut off on the vifual line 3, *s*, as is evident from the figure.

Obfervations.—The truth of the reprefentation of the three laft fquares will appear, if the whole fpace between 3 and 6 be placed from 6 to 9. Draw then from 9 a line to *d*, which will cut the vifual in the fame points as before, when a line was drawn from 6 to *b*.

The advantage of this problem is very much experienced in the reprefentation of long ranges of buildings, fuch as the internal views of ftreets; in which cafe it is impoffible to find room on the ground line for the full meafurement of each front, not even when we have a very large board to draw on. I remember to have been very much embarraffed myfelf in drawing the view of a long ftreet, till I was informed of the above methods.

SECTION

SECTION IV.

Of the representations of Polygonal and Curvilinear Figures—containing some further Remarks on the Difference between the Representation of Objects on a Plane, and their real Appearance to the Eye.—Of long and short Distances, and the Representation of a Row of Columns and Pilasters, parallel to the Picture; together with some Observations on the Theory of Circular Objects.

Of Polygonal Figures.

LINES in three different positions to the picture, will represent any polygon in any situation whatever *.

A pentagon may have one side parallel to the picture; and if so, the other four will be oblique to it; or it may be placed so as to have all its sides oblique.

* See the definition in page 49, and the various kinds of polygons in Plate II.

A hexagon may be so placed as to have two sides parallel, and the other four oblique, as Fig. 16, Plate XIX. or it may have all its sides oblique.

An octagon may have two sides parallel to the picture, consequently there will also be two perpendicular to it, and the remaining four will be each of them oblique, as Fig. 18, Plate XIX. The octagon in this situation, therefore, introduces all the variety of positions of lines that can exist in a picture, when the figure is supposed to be on the ground plane, or perpendicular to the picture; and since the theory of lines parallel, perpendicular, and oblique to the ground line, &c. has already been considered and applied to practice in the preceding section, in the representation of geometrical squares and of cubes, nothing is requisite here, but to apply the same principles to the representation of polygonal figures.

The most useful of these are the hexagon and octagon; which, for brevity's sake, I shall confine myself to, taking it for granted that, after the learner is acquainted with these, he will be able to delineate any other, from a pentagon to a duodecagon, as it may be found requisite.

PROB.

PROB. XV. FIG. 16. Plate XIX.

To repreſent a Hexagon having Two of its Sides parallel to the Picture.

OPERATION.—Draw the ground line and horizon, and make *s* the center of the picture, and *d* the diſtance. Through *d*, draw a line at pleaſure parallel to the horizon. From *d* deſcribe a ſemicircle, in which may be inſcribed half a hexagon, as 1, 2, 3. From *d*, through each angle of the hexagon, produce a line till it cut the horizontal line in V *v*; then will V *v* be the vaniſhing points of the four ſides of the hexagon, which are oblique to the picture. Draw the viſuals F *v*, B *v*, and B V, F V, and make B D and F A each equal F B, the ſide of the given hexagon. Draw A V, cutting the viſuals at I K; and draw D *v*, cutting at O N. Laſtly, draw K N parallel to F B, and the repreſentation will be completed as required.

Obſervations.—It is evident that a hexagon is compoſed of ſix equilateral triangles. The repreſentation contains ſix triangles alſo; and if a right line be drawn through each oppoſite angle, as from F N, &c. they will all interſect in the center *c*, in the ſame manner as the lines from each oppoſite angle on the

 plan

plan of the hexagon Y interſect each other in the true center, from which a circle may be deſcribed that will touch each angle.

PROB. XVI. FIG. 17. Plate XIX.

To find the Repreſentation of a hexangular Priſm, or Box, having two Sides parallel to the Picture, as before.

THIS problem may be ſolved by another method, which will help to confirm the truth of the laſt method.

Operation.—Draw the plan Y, and produce its ſides up to the ground line at *g*, *f*, *b*, *c*. Find the vaniſhing points *v* V as in the preceding problem. Draw the viſuals *g* V, *f* V, and *b v*, *c v*, which will interſect each other at *a*, *e*, *t*. Through *e* the center, correſponding with *e* on the plan, draw *b u* parallel to *q*, *r*, on the plan. From *v*, draw *v b*, produced to *o*; and from V, draw V *u*, produced to *n*. Laſtly, from *n* draw *n o*, which will complete the bottom of the box. Or it may be done by drawing the viſuals 8 V, 7 V, when the other viſuals are drawn, as the figure itſelf ſufficiently indicates. From each angle of the bottom perpendiculars muſt be raiſed, and produced at pleaſure. Next, draw *g p* perpendicular to the ground line, and make

make *g p* equal to the height of the box; and draw *p* V, and produce *n*, *o* to *i*; and from *i* draw *i k*, and from *k* draw a line parallel to the ground line, which will cut the aforesaid perpendiculars drawn from *o*, *n*, at 1, 6. The perpendiculars from *b*, *a*, were cut by *p* V at 2, 3. Draw 6 V, and 1 V, cutting the perpendiculars from *u* and *t* at 5, 4; from 5 draw 5 *v*, and from 4 draw 4, 3, and the outlines of the box will then be completed.

To ſhew the inſide, and the thickneſs of the edges of the box, proceed thus:—produce from the plan, *x w*, and from *w* draw a line to V, cutting *i o*; from its interſection in *i o*, raiſe a perpendicular to *k* 1; and from its ſection on *k* 1, draw a line to V; and where this line cuts the diagonal 2, 5, a line muſt be drawn from *v*, the vaniſhing point, to 9, the point of interſection, and produced till it cut the diagonal 1, 4, at 1; and from where it cuts this diagonal, draw a parallel to 1, 6; and from where it cuts at 6, draw a line to V; and from where this line cuts at 5, draw a line to *v*, cutting 4; and from where it cuts at 4, draw a line to the other interſection at 3, and the edges of each angle will be finiſhed.

Obſervations.—The hexagon in this figure is nearly the ſame in its plan as the other in Fig. 16; but as it is removed back from the picture, its appearance is more eaſy and natural

 than

than that. The hexagon in Fig. 16 has one ſide, F B, in the picture, therefore F B is the full length of the ſide of the original hexagon, and the contractions of the other ſides appear more ſudden, and therefore more unnatural; but its repreſentation is equally true. The hexagon may, however, be repreſented by this method as far back as we pleaſe, by repeatedly laying F B, the ſide of the hexagon, on the ground line, as from D to E, and drawing E *v*, by which means we have another hexagon 1, 2, 3, 4, K, Z, whoſe appearance is perfectly natural.

Prob. XVII. Fig. 18. Plate XIX.

To find the Repreſentation of an Octagon, having two Sides parallel to the Picture.

Operation.—Draw G R, the ground line, and H L as in common; and make *s d* the diſtance of the picture, and *s* the center. Draw half the plan of the octagon at A, as follows.—Make *b g* equal to half the breadth of the plan; and from *c* ſweep the arch *b*, *i*, *e*. Biſect the arch in *i*. From *i* draw *i c*, cutting at *p*, and *p g* will be half the ſide of the octagon. Lay on *b p* to *b* 1, and a line from *p* to 1 is one ſide of the octagon.

Produce

Produce each ſide of the octagon up to the ground line; and from the points *f*, 8, 1, *b*, draw viſuals to *s*. From 8 draw a line to *d*, cutting at 7; from 1 draw a line to *d* alſo, cutting at 6. From 7 and 6 draw lines parallel to the ground line, cutting at 2, 3. Draw *f d*, paſſing through the diagonal of the ſquare in which the octagon is inſcribed. Draw 4, 5, parallel to the ground line. Laſtly, draw the ſides 1, 2,—3, 4—4, 5—5, 6, and 7, 8; which completes the repreſentation.

PROB. XVIII. FIG. 19. Plate XIX.

To find the Repreſentation of an octangular Priſm, or Box, having all its Sides oblique to the Picture.

OPERATION.—Draw the ground line and horizon, and let figure A be half the plan of the octagon. Let *s* be the center, and *d* the diſtance of the picture. Produce *n e*, *n p*, to the ground line; and draw *g* perpendicular to *e*. From *b*, *g*, 1, R, draw viſuals to *s*; and from R draw R *d*; by which a ſquare will be repreſented in which the octagon may be inſcribed.

Draw the other diagonal of the ſquare, which will cut the viſual *g s* in 8; the other diagonal R *d*, cuts the viſual *g s* in 6.

From

From 6 draw a parallel to 4, cutting the diagonal at 4; and from 8 draw a parallel to 2, cutting the diagonal at 2; through the center of the ſquare draw a parallel, cutting at 7 and 3. Laſtly, draw right lines to each point, and the bottom of the box will be completed.

Draw A F parallel to G R, and at a diſtance from G R equal to the height of the box. Then repreſent another ſquare A, F, G, D, and draw the diagonal each way. Then from 8 raiſe a perpendicular to 10, cutting the diagonal A D at 10. In the ſame manner, and to the ſame effect, raiſe a perpendicular from 6 to 11, from 5 to 13, from 4 to 14, from 3 to 15, from 2 to 16, from 1 to *o*, and laſtly, from 7 to 12. Draw then, as before, right lines to each point, and the whole repreſentation of the box will be finiſhed, except ſhewing the inſide and the edges of the box: having deſcribed how this is to be done in Problem XVI, I need not here repeat it; only it will be neceſſary to obſerve, that as the ſides of the octagon are drawn by this method without vaniſhing points, theſe points muſt be found by producing the ſides of the octagon till they cut the horizontal line H L, in the ſame way as the ſide 15, 14, is produced to *v*, which will be the vaniſhing point required for drawing the inſide line to, as the figure ſhews.

Some

Some further Remarks on the Difference between the Representation of Objects on a Plane, and their Appearance to the Eye.

We have already, in page 210, obſerved, that a perfect picture of objects, as they appear to the eye, cannot be delineated on a plane; we may conceive it to be done on the ſurface of a ſphere, if the ſpectator's eye be in its center. But this is only a ſuppoſition; for, in reality, there can be no ſtrict rules given for drawing perſpective lines on a ſpherical ſurface. A painter, in delineating objects on the inſide of a large dome, may make uſe of ſtraight lines, and the rules of perſpective, as applied to a plane; but he does this, becauſe he perceives that the dome being exceedingly large, and the object but ſmall, the ſpace which the ſaid object occupies on the dome is nearly a level ſurface; and therefore common perſpective comes near enough to the truth for drawing that ſingle object.

But if the object be large, and the dome ſmall, nothing of this ſort can be applied.

Mr. Kirby has, indeed, propoſed a method to draw perſpective repreſentations upon vaulted roofs and domes; and, for

any thing I know, it is as good a method as can be adopted; yet it cannot be called perfect, much less a system of linear perspective applicable to spherical surfaces *.

But the ordinary rules of perspective applied to a plane is a perfect system, as it relates to the representation of objects according to their real appearance on a transparent plane interposed between the eye and the original figure of any thing: for the transparent plane, in this case, is a section of the rays of light coming from the object to the eye; which section is therefore an infallible and most perfect perspective representation of the original figure on a plane; but it is not so perfect to the eye, because the eye is globular.

Perspective then, as it respects the appearance of objects on a plane, is perfect, and its rules are strictly mathematical; but as it respects the appearance of those objects to the eye, it is a deception, and is therefore liable to defects and imperfections, as every other deceptive art is, owing to various circumstances depending on the management of the artist. These distinctions have not been sufficiently attended to by some, which has therefore been the occasion of some disputes on this subject not well founded.

* As this subject is foreign to my purpose, and not likely to be of use to those persons I wish to serve in this work, I shall not enter upon it, but if the reader chuses, he may consult the third section, page 74, of the above gentleman's book.

Hence

Hence it has been ſaid, by a certain writer, that a row of columns, or cylinders, cannot be repreſented parallel to the picture, without producing a clumſy and bad effect, if they be drawn according to the ſtrict rules of perſpective; for then thoſe columns which are furtheſt from the center will be the largeſt, which ought rather to be the ſmalleſt, according to their appearance to the eye. But this depends on circumſtances, and is not a ſufficient reaſon for charging the rules of perſpective with falſity, or even a defect, unleſs the laws of this art obliged us always to chooſe a very ſhort diſtance; and that, when we view a picture, we muſt neceſſarily hold our noſe cloſe to it, before we can be a judge of the merit of perſpective.

From pretty much the ſame principles another gentleman, who writes on this ſubject, gives us an inſtance of the imperfections of perſpective, by repreſenting a geometrical ſquare, with a very ſhort diſtance, which occaſions the ſquare to look too long one way, which he therefore terms a falſe repreſentation, though he has obſerved the ſtrict rules of perſpective. Yet I will venture to ſay, having made the experiment, that if this gentleman had placed his eye perpendicular to the center of the picture, and at a diſtance from it equal to that by which he drew the ſquare, he would not have diſcerned any bad effect even in that which he calls a falſe repreſentation. But that the learner may have a proper view of this ſubject, I ſhall firſt re-

 preſent

prefent a row of columns as they appear to the eye; and, fecondly, reprefent the fame row as they appear on a plane, by which the learner will fee the difference between Mr. Kirby and Mr. Malton's opinions on the fubject. And, thirdly, we fhall fhow the aforefaid row of columns on a plane, having the advantage of a long diftance, which, in this cafe, is recommended both by Malton and Noble; the effect of which being a proof that we may abide by the ftrict rules of perfpective in delineating a row of columns, or any other cylindrical object, and that more pleafant to the eye than when they are reprefented according to Mr. Kirby's opinion and definition of perfpective, which is, "to draw the reprefentations of objects as they appear to the eye." See page 94 of his Treatife on Perfpective.

Firft, to delineate a row of columns according to Mr. Kirby's definition.

Of the Reprefentation of a Range of equidiftant Columns parallel to the Picture.

FIRST, Let I, K, L, M, Plate XX. Fig. 20, be confidered as a horizontal fection of the four columns A, B, C, D; and let the arch 1, 2, 3, 4, &c. be the fection of a fpherical picture, and *d* the diftance of the eye from the picture, then will *s* be its cen-

-ter.

ter. Draw from the apparent diameters of each column viſual lines to d; and where theſe rays cut the arch at 1, 2, 3, 4, &c. will be the repreſentation of the diameters of the four columns as they appear to the eye. Theſe diameters and their inter-columns, or ſpaces between, muſt now be transferred to a level plane or picture, as in No. 1. Draw a line A B, and take 1, 2, from Fig. 20, and place it at 1, 2, No. 1.; then take 2, 3 from Fig. 20, and place it to 2, 3, No. 1. and ſo of all the others. Draw perpendiculars from each number, and finiſh them, as exhibited in the figure, and they will be the repreſentations of the four columns A, B, C, D, as they appear to the eye.

Secondly, We ſhall now repreſent the ſame columns as they appear on a plane, having the ſame center and diſtance as before. Draw the line P P, Fig. 20, parallel to the four columns, which will be the ſection of the picture; and ſince the viſual rays from each column were drawn before, the repreſentations of the apparent diameters of the ſaid columns on a plane will be at *a b*, *c e*, *f g*, *h i*. Transfer theſe diameters and their inter-columns to No. 2, as the figure ſhews; then will A, B, C, D, be the appearance of the four original columns at Fig. 20, on the plane of the picture, according to the ſtrict rules of perſpective.

Now

Now the queſtion is, Which of theſe repreſentations are moſt alike to the originals in Fig 20? If the reader will place his eye perpendicular over A, the center column in each repreſentation, and look through his hand at a diſtance equal *d s*, Fig. 20, I believe he will be able to determine for himſelf; nevertheleſs it may be proper to offer ſome remarks by way of aſſiſting his enquiries. And, firſt,

We may obſerve that the whole ſpace which includes the columns at No. 2, is conſiderably nearer the length of the originals at Fig. 20. than the ſpace which No. 1. includes. The intercolumns are nearer alike at No. 2 than they are at No. 1. And, laſtly, if we look ſteadily through our hand as above directed, we ſhall find that, at No. 2, the apparent thickneſs of the column D will be greatly reduced, and that of C will be alſo reduced, and both in proportion to their diſtance from the center, ſo that there will not be much difference in the thickneſs of each. But if we look in the ſame manner at No. 1, we ſhall find the repreſentation appear worſe, for D C will appear ſmaller than they are repreſented. The reaſon is obvious, for the rays of light by which viſion is performed, being conſiderably oblique at the column D and C, the optic angles which they ſubtend are much leſs than thoſe ſubtended by A and B, as Fig. 20 clearly demonſtrates; for the rays G *d*, H *d*, are more oblique to

the picture PP than the rays N d, O d; therefore we see that the arch 7, 8 is less than the arch 5, 6, and so of the rest in proportion.

The figure also demonstrates, that when these visual rays are cut by a plane PP, parallel to the original columns, the effect is reversed; for then the representative diameters will increase as they decline from the center s, yet the optic angles under which they are seen remain the same as before, when the visual rays were cut by a spherical picture at 1, 2—3, 4, &c.

Hence it is evident, that the diameter $b\, i$, viewed by an eye at d, would not appear larger than the diameter 7, 8 on the arch. Wherefore the true representations of the original range of columns as they would appear on a transparent plane, interposed between the spectator's eye and the said original columns, are at No. 2, not at No. 1, for that is their representation on a sphere, as they appear to the eye, answering to Mr. Kirby's definition of perspective, though this is not what he means to recommend in practice; for he says, page 97, "that they" (meaning a range of equidistant columns) "should be so represented as not to offend "the eye of a common observer;" by which he means they should be drawn of one thickness, and at equal distances. How far the representation at No. 1, which is according to his definition,

tion, will agree to this, I will leave to the judgment of the reader, and ſhall proceed to ſhew how theſe columns may be repreſented, according to the ſtrict rules of perſpective, ſo as to appear of one thickneſs, and at equal diſtances.

We have hitherto ſuppoſed the eye of the ſpectator at *d*, viewing the original columns A, B, C, D, Fig. 20, in which ſituation the viſual ray H *d*, from the fartheſt column D, and the eye's axis *d s*, form an angle of fifty-four degrees; and ſince *s i* is but half the picture, the whole would be ſeen under an angle of one hundred and eight degrees, which is far too great for viewing any picture; for the eye at *d* cannot take in a ſpace twice the length of *s i*, without being ſtrained and twiſted.

To convince the learner of the truth of this, let him take a pair of compaſſes and extend them from *d* to *s*, and placing one foot on the column A, at No. 2, let the other foot keep his right eye from A, exactly at the diſtance of their opening, equal *d s*. Obſerve, the compaſs foot muſt nearly touch the right eye, or the experiment will not be ſo ſtriking. The eye being thus placed, experience will teach him that he cannot ſee the column D at No. 2 without twiſting his eye; and at the ſame time he will ſee, as we ſaid before, that the columns will be nearly equal in thickneſs. But if the eye *d*, at Fig. 22, be removed back to E,

the

the whole picture will be feen with eafe, for it will only fubtend an angle of forty-eight degrees; and at this diftance, the vifual rays being not fo oblique to the picture as before, they will cut it nearly at equal diftances from each other, as is denoted by the afterifms * *, where the dotted rays cut PP. The good effect produced on the picture P P, by choofing E for the diftance, is clearly demonftrated by Fig. 21, which exhibits the fame row of columns drawn by the diftance E.

Thus:—make *s d*, Fig. 21. half the fpace of E *s*, Fig. 20; becaufe there is not room for the whole diftance on the plate. From *s* draw *s* A perpendicular to H L. Draw G R as a ground line, and proceed as before to lay on the fpaces marked by the afterifms * *, Fig. 20, on the line P P. Draw then the vifuals from A, B, D, C, as the figure fhews. From 1, Fig. 23, draw a line to *d*, cutting A *s* in 2. Through 2 draw a line parallel to G R, cutting the vifuals; by which will be reprefented four geometrical fquares, in which the bafes of each column will be infcribed. Laftly, from the circles contained in each fquare, draw the fhafts, and finifh them as in the figure. Now let the reader place his eye perpendicular over *s*, and at a diftance from *s* equal twice *s d*; then I am perfuaded he will fay, that a common obferver would pronounce the columns of equal thicknefs, and their intercolumns equidiftant, although they are reprefented according

to the ſtricteſt rules of perſpective; which Mr. Kirby thinks we muſt not abide by in this caſe.

Before I conclude this head, it may be proper to take ſome notice of the repreſentation of a row of equidiſtant pilaſters.

A little reflection will make it evident, that the repreſentation of a row of pilaſters parallel to the picture, are not ſubject to thoſe awkward appearances which columns are, owing to a ſhort diſtance. For,

Let the dark line 9, 10, on the column D, Fig. 20, be a pilaſter, equal in width to 13, 14, on the column A. Draw the viſuals 9, 10, to *d*, cutting the picture P P at 11, 12; then will the ſpace 11, 12 be equal *a b*, cut by the rays from the pilaſter 13, 14; for as the pilaſter 9, 10 is to 13, 14, ſo will 11, 12, *a b*, their repreſentations, be to each other. The ſame reaſoning ſhows us why columns increaſe in thickneſs as they decline from the center of the picture, if we obſerve where the viſual rays, drawn from their apparent diameters, cut the line paſſing through their centers, as *t v*, *k l*; wherefore, as *k l* is to 13, 14, ſo is *b i*, the repreſentation of the column D, to *a b*, the repreſentation of A. And hence it is evident, that in the repreſentations of buildings whoſe fronts are parallel to the picture, their

doors

doors and windows will be to each other as their originals are; that is, if the windows and ſpaces between them be equal in width, their repreſentations will be equal alſo; and, as Mr. Martin obſerves, "all plane ſurfaces whatever, placed in a front wall or plane, will have in their perſpectives no change of figure at all; a ſquare, a parallelogram, a triangle, a pentagon, a circle, an ellipſis, &c. will be all the ſame figures on the perſpective plane, and perfectly ſimilar to the originals; and this will hold good in every part of ſuch a plane in front, as well above and below the horizon, as on each ſide the eye*."

Of the proper Choice of the Diſtance of the Picture, proportioned to the Height of the Horizon, and the Nature of the Object to be repreſented.

FROM what has now been hinted reſpecting long and ſhort diſtances, the learner will naturally wiſh to know ſome fixed principle about it, and what is the general rule for chooſing a diſtance.

To give him all the ſatisfaction I can on this ſubject, I ſhall propoſe the following remarks.

* See his Principles of the Genuine Theory of Perſpective, page 51.

There

There is a certain diſtance ſhorter than which the eye cannot eaſily ſee a picture; and therefore if an object be delineated by ſuch a diſtance, it will appear unnatural.

In Plate XIV. Fig. 1, let BD be the length of the picture, and Z the place of the ſpectator's eye, and *e* the center of the picture, then will Z*e* be the diſtance of the picture; but as Z*e* is very little more than half the length of the picture BD, therefore the angle under which the whole picture would be ſeen at Z, is almoſt ninety degrees.

This is an angle which the eye cannot eaſily take in, becauſe the ray ZB is in a ſtate too diverging to the pupil of the eye, and therefore the ſpectator muſt twiſt and ſtrain his eye, before he could ſee the whole extent BD.

The optical reaſon of this is as follows:

Produce the viſual rays LP, KP. Now, it is evident, from the ſcale on the arch, that theſe rays ſubtend an angle of more than ninety degrees. Therefore ſince, according to optical laws, rays will not unite in a point on the retina at a greater obliquity than an angle of forty-five degrees, conſequently the points KL will not appear to the eye. This is probable enough from the figure

figure of the eye, for the image *s* of K, and *o* of L, are too far forward in the eye to be feen; but by turning the eyes a little towards K or L, it is evident they will become vifible; for then P *e*, the axis of the eye, will perhaps be turned to 20; or, on the other hand, at 40; confequently the angle of obliquity 20, P K, being confiderably lefs than forty-five degrees, the pencil of rays from the point K will unite in a point on the retina, and fo become vifible.

A fimple experiment will convince the reader of the truth of this. Take a lath two feet long, and at the center fix a wire in a perpendicular direction, about thirteen inches long, or we fhall fay twelve inches, for then a thread ftretched from the wire to each end of the lath would form an angle of 90; that is, the threads will be perpendicular to each other. The end of the wire being held clofe to the eye, the experimenter muft look along each thread at once, and try if he can fee them diftinctly at each end of the lath at the fame glance, without ftraining his eyes. If he continue to do fo a few minutes, the pain which this gives will be a fufficient proof that the eye cannot eafily take in an angle of 90; and that therefore twelve or thirteen inches is far too fhort a diftance for a picture two feet long.

Therefore,

Therefore, in Fig. 1, if the eye be removed to P, the angle which the rays D P, B P make with the picture B D is confiderably lefs, and hence the eye at P will more eafily take in D B, the whole extent of the picture; becaufe the rays D P, B P do not diverge fo much at the pupil as before. If, therefore, the aforefaid wire be lengthened in the proportion of P *e* to B D, which will be as twenty-one inches are to twenty-four, the whole length of the lath; and if threads be fixed as before, reprefenting the vifual rays D P, B P, the eye P, placed at the end of the wire, will eafily fee at one glance both the threads B D.

This experiment, therefore, induces me to conclude that a picture which is filled the whole length with objects on the front, fhould never be drawn by a diftance fhorter than the perpendicular of an equilateral triangle, whofe fides are equal to the whole length of the picture. The angle B, P, D, is equilateral, and P *e* is its perpendicular; and that I take to be the fhorteft diftance that fhould be ufed in this cafe. And I will venture to affirm, from experience, that any perfon who has never once thought on this fubject, when viewing a picture two feet long, will not ftand lefs than twenty-one inches from it when he wants to fee the effect of the whole; but if he would examine minutely fome particular part feparately, he will naturally

turally approach nearer to the picture, in proportion to the ſize of the part thus examined. Whence, I alſo conclude, if nature is to be a guide in matters of delineation and painting, that the diſtance of the picture ſhould be as 21 is to 24, ſo is the proper diſtance to the ſpace which the front objects occupy on the picture. For, ſuppoſing a picture two feet long to have only two or three regular objects on the front, occupying not more than two thirds of the whole length, which is ſixteen inches, it would not be neceſſary in this caſe to make the diſtance twenty-one inches. A diſtance of fourteen or fifteen inches would then be ſufficient, and produce a more agreeable effect in the appearance of the regular objects, both in front and back, than when drawn by a much longer diſtance. For, if front objects are too much fore-ſhortened by a long diſtance, thoſe on the back ground will be much more ſo, and appear too tall for their thickneſs; and the whole picture will want depth, eſpecially if it be an internal view of a ſtreet, a long room, or any thing of this nature, where the eye is ſuppoſed to be pretty near the firſt object.

I ſhall now apply the foregoing principles to a few practical caſes, by which the learner will ſee the effect of long and ſhort diſtances, and how to chooſe them on particular occaſions.

How to chooſe a Diſtance, when the whole Length of the Picture is filled with Objects on the Front.

LET *p r*, *o t*, Fig. 22, Plate XX. be the lines which mark out the length of the picture filled with ſquares on the front.

Extend the compaſſes from *v* to *v* on the horizon, and ſweep the arch *v* D, D *v*; then will their interſection D be the proper diſtance in this caſe, and *s* will be the center. Make *s* V each way equal *s* D, and V will be the working diſtance, as the figure ſhows.

The ſquares C, K, N, O, drawn by the diſtance *s* V, are perfectly natural. But the ſquares E, P, Q, R, drawn by *s v*, are not ſo; becauſe the diſtance is vaſtly too ſhort; for the eye at *d* views the picture in an angle of ninety degrees, which, as we have already ſhewn, is far too great, and therefore the repreſentation of the ſquares are unnatural to a common obſerver. But if the reader place his eye perpendicular to *s*, and at a diſtance from *s* equal *s d*, he will find that the unnatural length of the ſquares, from front to back, will be greatly diminiſhed in appearance.

On the other hand, it is equally neceſſary to avoid chooſing a diſtance too long; the effect of which is ſeen at the ſquares F, where they appear too narrow from front to back; for the diſtance at *z* forms, with the whole length of the picture, an angle only of 48 degrees; which ſhould not be admitted, except in particular caſes, as in the repreſentation of a row of columns parallel to the picture in Fig. 20, where the eye at E is in the ſame angle with the picture twice PP, as at *z*, Fig. 22.

How to chooſe a Diſtance, when the Objects are drawn by a large Scale, ſituated not far from the Center of the Picture.

Let *p t*, Fig. 22, ſtill be conſidered the whole length of the picture; and let M be the repreſentation of a ſquare, on a much larger ſcale than that at C; and let its ſituation at M be much nearer to F, the center ſquare. From *s*, the center, extend the compaſſes to *t*, the extreme point of the picture, and ſweep the arch *t*, *c*, *b*, then will *c* or *b* be a proper diſtance in a caſe of this kind; for the ſquare M, drawn by the diſtance *c*, appears perfectly natural, which would be too long were it drawn by V, the former diſtance, as appears by the diagonal drawn from 10 to V, cutting the viſual 9, *s* at *a*. This by no means contradicts what has been advanced in page 178; where we ſay, that " a picture filled with objects on the front, ſhould never be drawn by a

 diſtance

diſtance ſhorter than the perpendicular of an equilateral triangle, whoſe ſides are equal to the whole length of the picture." For, let the line 9 be now conſidered the bounds of the picture, and it will be evident, by drawing a line from *b* to *g*, that the diſtance *s b* is greater to the picture at 9, than *s* D is to the picure at *t*, otherwiſe *b g* would be parallel to D *v*.

Another advantage may be obſerved in this method, if we conſider that a very high horizon will produce as much diſtortion in a picture as too ſhort a diſtance. Therefore if we ſuppoſe the horizon to be made higher by the ſpace *t i*, the diſtance will then be *s i*, in the ſame proportion to it as *s c* is to *s t*.

How to chooſe a Diſtance, when a Piece of Furniture, not very long, is repreſented by itſelf on the Center of the Front of the Picture.

IF a ſingle object, or piece of furniture, be repreſented by itſelf on the center of the ground line, an equilateral triangle being drawn, whoſe ſides are equal to the length of the piece of furniture, the perpendicular of this triangle added to the height of the horizon, will be a very agreeable diſtance in ſuch a caſe. Thus, at the ſquare F, ſuppoſed to be the plan of a piece of furniture repreſented on the center of the ground line, extend the compaſſes from 10 to *x*, and ſweep the arches, to form an

equilateral

equilateral triangle, whofe perpendicular will be at *w*; then will *s w* be the diftance propofed in this cafe. But if the piece of furniture be of an extraordinary length in front, in proportion to its breadth from back to front, then it will be beft to adopt the preceding method; for if we fuppofe the piece of furniture to extend from 7 to 9, then a perpendicular of an equilateral triangle of that dimenfion added to the whole height of the horizon, would forefhorten too much. Of thefe things I am perfuaded the reader will be convinced, if he make the experiment as the cafes are here ftated.

Of the Reprefentations of circular and curvilinear Figures, both plain and folid; together with fome Remarks on their Theory.

THE manner in which fome painters and defigners treat circular objects, would lead one to fuppofe that there is no certain theory on which to build the practice of drawing objects of that kind.

Sometimes we may fee a cafk, if not fhewing both ends, yet the end on which it ftands is reprefented by a curve confiderably more flat than that by which its top is fhewn; than which nothing can be more abfurd, for the very reverfe is the truth.

We may alſo ſee, in ſome cabinet deſigns, the bottom of a round fronted cheſt of drawers, or commode, repreſented by the ſame curve as that which repreſents the top part; which, though not ſo ridiculous as the above, is far from being ſcientific, or according to the rules of perſpective. That the learner may avoid theſe miſtakes, and have a proper conception of this matter, we ſhall propoſe the following ſhort theory.

Caſe 1.—If an original circle be ſituated in a plane parallel to the picture, its repreſentation will be a circle.

Thus:—Let A, B, O, D, Plate XIX. Fig. 20, be an original plane parallel to the picture H, I, K, in which is ſituated a circle *a*, *b*, *d*, *e*, whoſe repreſentation on that picture is required.

The viſual rays from each diameter of the original circle tending to the eye E, are cut by the picture or plane of projection H, I, K, in a parallel direction to the original plane A, B, O, D. Wherefore we have the diameter 4, 2 drawn perpendicular to *a d*, its original. Alſo we have the diameter 1, 3 parallel to its original *b e*; conſequently the diameters 1, 3—4, 2, are the repreſentations of their originals *a d*, *b e*. C is the center of the original circle, and a line from C to E biſects the triangle *b*, E, *e*; conſequently *c* is the repreſentation of the center C. Laſtly, the radii or ſemidiameters *c* 1, *c* 2, *c* 3, *c* 4, are equal and ſimilar to their originals,

originals, and therefore any one of them, as *c* 1, will deſcribe the circle 1, 2, 3, 4, which will be the true repreſentation required. The truth of this may alſo be proved, by conſidering the viſual rays *b* E, *d* E, &c. as the ſides of a cone whoſe vertex is at the eye E, and whoſe baſe is the original circle *a*, *b*, *d*, *e*, and its axis C *c*. Now it is evident, that if a cone have a ſection parallel to its baſe, the curved boundary of that ſection is a circle, in like manner as a pyramid, whoſe baſe is a geometrical ſquare, produces a geometrical ſquare, if its ſection be parallel to its baſe. See page 230. Plate XV. Fig. 6.

By the above theory we ſhall eaſily judge how to proceed in the repreſentation of arches, when they reſt on pillars or piers parallel to the picture. And it ſhould be obſerved, that in whatever ſituation the original arch or circle may be in with reſpect to the center of the picture, if they be parallel to the picture, their repreſentations will be ſimilar to their originals *.

Caſe 2.—If an original circle be ſituated in a plane not parallel to the picture; that is, if it be the repreſentation of a circular object lying on the ground, or in any plane parallel

* The reader may, if he pleaſe, conſult Dr. Brook Taylor's ſecond corollary of theorem fourth, p. 16.

with it, its reprefentation on the picture will be an ellipfis. The reader who has previoufly made this fubject his ftudy, may afk what I mean by the term ellipfis in this place? fince fome have difputed whether the reprefentation of a circle in the above cafe be a regular ellipfis, or a curve of fome other fpecies of the conic fections. Mr. Noble has difcuffed this point in oppofition to the critical reviewers, who had cenfured Mr. Ware in his tranflation of Sirigatti's perfpective, becaufe the tranflator had defined the reprefentation of an original circle fituated in a plane not parallel to the picture, to be a regular ellipfis. In oppofition to which definition of Mr. Ware's, the Critical Reviewers for July 1756, page 509, make the following obfervations.

" In regard to his regular ellipfis for the reprefentation of a circle, it appears, from the very nature of perfpective, that the fore part of a circle will appear more round than the back part, which being further removed from the eye, cannot appear to have the fame degree of curvature; and confequently the whole figure, if drawn, muft be very far from having the form of fuch an ellipfis as is to be made by a tranfverfe and conjugate diameter."

Mr. Noble, in oppofition to the above remarks, attempts to prove that the reprefentation in queftion muft be a regular ellipfis; but his arguments are fo abftrufe, that if they were founded

founded in truth they would not be convincing to the ordinary reader, and therefore I ſhall not trouble him with them, but proceed to offer a remark or two in confirmation of thoſe made by the Reviewers, which I think eaſily underſtood. Let A, B, C, D, Plate XXI. Fig. 23, be the repreſentation of a geometrical ſquare in which an octagon and circle may be inſcribed. The circle, truly repreſented, will touch every ſide of both the ſquare and octagon, as ſhewn by the figure. Now, I cannot ſee by what mode of reaſoning we can prove that the ellipſis is regular any more than we can prove that the octagon is regular, becauſe it is the repreſentation of one that is ſo; but, perhaps, to uſe Mr. Noble's words, "we are ignorant of thoſe few geometrical præcognitæ which alone can render us capable of conviction on this point:" and this may be the reaſon why I have conſidered Mr. Noble's arguments ſo abſtruſe*. At the ſame time I do not think the Reviewers were ignorant of thoſe few firſt principles of geometry, nor even wanted their recollection, when they animadverted on Mr. Ware. They juſtly ſay, "that the fore part of a circle will appear more round than the back part," which muſt be evident to every one, by obſerving that the whole curve on this ſide of the diameter $g\ c$, is what they mean by the fore part of the circle,

* The reader, if he chooſe, may ſee the arguments in Noble's Linear Perſpective, page 142.

and

and all beyond *g c* is confidered the back part of it. We may alfo obferve, that the curves contained in the quarter parts of the ellipfis are not one of them fimilar to another. How then can we pronounce it a regular ellipfis? When we fpeak of the perfpective appearance of any original object, do we not denominate it by the figure which it affumes upon a plane, and not as it appears to the eye? where then is the good fenfe or propriety of calling that a regular ellipfis which is no way regular? One would think Mr. Noble had forgotten the diftinction which he fo properly maintains in other parts of his book, namely, between the appearance of objects to the eye, and their reprefentation on a plane; for if we ftand at a diftance from the top of a round table, it will appear to the eye a regular ellipfis; but if the top be reprefented on a picture according to that diftance, it will be an irregular ellipfis, and its irregularity will be in proportion to the fhortnefs of the diftance of the picture. But fuppofe we were to confider *b d* the tranfverfe diameter, and confequently *b f* the conjugate, yet there is a manifeft difference between the two femi-ellipfes. Nor is it poffible to draw a tranfverfe diameter in fuch a direction, as when the two femi-ellipfes are turned down on each other that they would coincide. Yet it muft be obferved, that if the reprefentation were drawn in the center, and by a long diftance, it would, in this cafe, approach fo near a regular ellipfis as the difference could not be eafily difcerned.

From

From what has been ſaid, the learner muſt obſerve then, that when he proceeds to draw the repreſentation of an original circle, he muſt not think of applying the compaſſes or trammel to draw it by; but a number of points muſt be found, through which the path of the ellipſis muſt be directed by a hand ſuperior to his who only can draw an ellipſis by a trammel or compaſſes.

Of the Repreſentations of circular and curvilinear Figures, both plain and ſolid.

PROB. XIX. FIG. 23. Plate XXI.

To repreſent a Circle lying on the Ground Plane, or when it is ſituated in any Plane parallel to the Horizon.

OPERATION.—Let H L be the horizon, and G R the ground line, *s* is the center of the picture, and *d* its diſtance. Make *s v* equal *s d*, and draw *d* V at right angles to *d v*, then will *v* V be the vaniſhing points to four ſides of the octagon. Make V M equal V *d*. Likewiſe make *v m* equal *v d*, and M *m* will be the true meaſuring points. Draw a half plan of an octagon, as was ſhewn in Problem XVII. and Fig. 18. Make A D equal to the diameter of the given circle. Draw the viſuals 2 V, 1 *v*, indefinitely.

finitely. Make 2 P, 1 *l* equal 2 *q*, the ſide of the octagon; and draw from *l* and *p* meaſuring lines to their reſpective points M *m*, cutting at 3 and 8. From 3 and 8 draw 3 *s*, 8 *s*. Take the ſpace 1 D, and lay it from D to 10, and from A to 12. From 12 draw a line to V, cutting at 7, 6. From 10 to *v* do the ſame, cutting at 4, 5. Laſtly, draw 5, 6 parallel to 1, 2, and the octagon in which the given circle is to be inſcribed is completed.

Method ſecond.—In this method, which is very ſimple, we proceed without regard to any of thoſe lines uſed in the firſt method, which was more ſcientific, and according to Dr. Brook Taylor's ſyſtem. The ground plane F is ſuppoſed to remain as before. Let A, B, C, D, be the repreſentation of a geometrical ſquare, found by the diagonals paſſing to each vaniſhing point, conſequently S will be the center. Through S draw *g c*, and draw *a s*, from which we have four points, *a*, *g*, *e*, *c*, of the intended circle. Draw a line from 2 to V, and from 10 to *v*, cutting the diagonals at *b*, *d*, whence we have two more points. From the points *b* and *d* draw parallel lines, cutting the diagonals in the points *h f*, adding other two; which in all make eight points, ſufficient for the repreſentation of the given circle.

N. B. A quarter plan F is ſufficient for this method.

Method third.—Draw the quarter plane of the circle to be reprefented, contained in the fquare A, E, *a*, O. Draw the diagonal O A; and from the point *n*, where the diagonal cuts the arch E *a*, raife a perpendicular to *t*. Reprefent a fquare as before, drawing its diagonals each way. From *t* draw a vifual to *s*, cutting the diagonals in the points *b f*. Laftly, from the points *b* and *f* draw parallels to the other diagonals, cutting at *b* and *d*, by which method there will be eight points gained as before. This laft method being fo fimple, and totally divefted of every thing that can any way perplex the learner, it has been adopted in the following problems, and in moft of the reprefentations in this book. There are, however, various other methods of effecting the fame thing, which might prove more pleafing to men of fcience, but which would not be fo advantageous to the workman, nor even to the artift, with whom facility and difpatch are principal objects.

Prob. XX. Fig. 24. Plate XXI.

To reprefent a Circle fituated in a Plane perpendicular to the Ground Plane.

Operation.—Let the line R be the ground line, and L the horizon, *s* is the center of the picture, and *s d*, on the vertical line, the diftance. Draw half the original circle B, *n*, C. Draw

 the

the diagonals *o* D, *o* A; from A and D reprefent a geometrical fquare, by drawing a line from A to *d*, cutting at F. From 1, 2, draw parallels to 3, 9; and from 3, 9, direct vifuals to the center *s*, and the diagonals of the fquare will be cut at 8, 5, 6, 7, forming four points, by which the reprefentation of the circle may be correctly drawn.

Prob. XXI. Fig. 25. Plate XXI.

To reprefent a Cylinder erect on the Ground Plane.

After what has been faid on the preceding problem, it is fcarcely neceffary to fay any thing on this; and therefore I fhall only obferve, that having drawn the bafe of the cylinder by the fame method as in the laft, proceed to raife perpendiculars from A, B, D, C; and from *a* draw *a b* parallel to A B, at a diftance from A B equal to the original length of the cylinder. From *a b* reprefent another fquare, as *a*, *b*, *c*, *q*. Draw its diagonals and diameters. From the point 4 raife a perpendicular till it cut the diagonal *b c*. From the point 7 raife one till it cut the diagonal *a q*. Do the fame at the points 6 and 5, and eight points will be found at the top correfponding with thofe on the bafe, by which the cylinder may be completed.

Prob.

Prob. XXII. Fig. 26. Plate XXI.

To find the Reprefentation of a Cylinder lying on the Ground, whofe Sides are oblique to the Picture.

Operation.—Draw the ground line and horizon as ufual; and let *s* be the center, and *d* the diftance of the picture. Make *s v* equal *s d*, and from *d* draw *d* V at right angles to *v d*, then will *v* V be the vanifhing points of the ends and fides of the cylinder. Make a half plan of the bafe of the cylinder at *a*, *b*, *c*, *d*, as in the preceding cafes. Draw C A perpendicular to the ground line, and equal to the diameter of the cylinder. Draw the vifuals C *v*, A *v*, and C V, A V. Make C F equal C A, and C S equal to the given length of the cylinder. Draw F *m*, S M, cutting at D and 3. Draw D B perpendicular to the ground line, and we have a fquare in which the end of the cylinder is to be infcribed. In like manner reprefent a fquare at the other end, as 1, 2, 3, 4; and having drawn the diagonals and diameters of both fquares, draw parallel lines from 5, 6 to *e f*. From *e* and *f* direct vifuals to V, cutting *g* and *h*; from *e*, *f*, *g*, *h*, draw vifuals to *v*, which will cut the diagonals of each fquare in four points, by which each end of the cylinder may be completed.

N. B.

N. B. A circle or cylinder may be reprefented without drawing a plan, by dividing the given diameter *c a* into feven equal parts, one of which will cut the diagonals as before, at leaft near enough for practice.

PROB. XXIII. FIG. 27. Plate XXI.

To find the Reprefentation of a femi-ellipfis, whofe tranfverfe Diameter is parallel to the Picture.

OPERATION.—Draw the ground line and horizon as in common, and let *s* be the center, and *d* the diftance of the picture. Make then a plan of the femi-ellipfis, whofe tranfverfe diameter is D G, parallel to R, the ground line. Draw A B, including half the conjugate diameter. Draw the diagonals O B, O A, cutting the ellipfis at P and N. Divide A D at K, and draw E F. From E, P, N, F, O, raife perpendiculars to the ground line at 4, 5, 6, 7, 8, 9, 10, and from each of thefe draw vifuals to *s*. Make 3, 2, 1, each refpectively equal A, K, D; and from 1, 2, 3, draw lines to *d*, the diftance, cutting at *a*, *k*, *b*. From *a*, *k*, *b*, draw parallel lines to *g*, *l*, *c*; and laftly, draw *o a*, *o g*, then will the feveral vifvals be cut at the points requifite for defcribing the elliptic curve, as the dotted points in the figure fhow.

PROB.

PROB. XXIV. FIG. 28. Plate XXI.

To find the Repreſentation of an elliptic Segment inverſely.

SUPPOSE A, B, C, D, to be the ſhelf of any table, &c. hollowed in front in the figure of an elliptic ſegment, A, 1, 2, 3, 4, D. Having drawn one ſide A, 1, 2, 3, 4, of the given ſegment at pleaſure, divide the curve into four equal parts, and from 1, 2, 3, 4, raiſe perpendiculars to *a*, *b*, *c*, *f*; then, to make the other ſide of the curve ſimilar to that already drawn, lay on the ſeveral diviſions *f*, *c*, *b*, *a*, to the right hand, and from theſe let fall perpendiculars at pleaſure; then, from 1, 2, 3, draw parallel lines, cutting the correſponding perpendiculars on the right hand, by which the other half of the ſegment may be accurately drawn. The plan being thus prepared, draw viſual lines to *s*, the center, and make *d* the diſtance. At *a* fix one foot of the compaſſes, and extend the other to 1, and with it ſweep the firſt arch; and in like manner ſweep the arches 2, 3, 4. From the ſeveral points where thoſe arches cut the line A D, direct lines to the diſtance, cutting the ſeveral viſuals at the points 1, 2, 3, 4. Laſtly, from 1 draw a parallel to 7, from 2 draw one to 6, and from 3 draw one to 5; thus will ſeven points be found through which the path of the repreſented curve muſt paſs.

SECTION

SECTION V.

The Application of the preceding Problems to the Practice of Drawing the Representation of Pieces of Architecture, and particularly various Pieces of Furniture in different Positions to the Picture.

THE preceding problems, and the various figures referred to, muſt be conſidered as only laying the foundation for the repreſentation of more compound objects, conſiſting both of right and curvilinear parts. It becomes neceſſary, therefore, to ſhew the moſt eaſy application of theſe problems in a variety of examples, that the whole may appear practical and uſeful, and that we may alſo ſee the real effect of that art which we have hitherto laboured to underſtand. Nor do I think that perſpective could well be applied in many caſes without ſuch examples. Beſides, the uſefulneſs of having a few proper examples always ready to turn to, muſt be of conſequence to thoſe who but ſeldom repreſent things in perſpective; in which caſe the rules and methods will frequently eſcape the memory, and make it neceſſary to have recourſe to the book; and for the ſake of more readily finding the explanation of each example, the page of letter-preſs where the explanation begins, is engraved on the copper-plate, it being a practice ſometimes to

to look at the plates firft for an example of what we intend drawing.

Example I. Fig. 29. Plate XXII.

How to reprefent a receding and returning Flight of Steps whofe Rifers are parallel to the Picture.

Let HL be the horizontal line, *s* the center, and *d* the diftance of the picture; GR is the ground line. Make AB on the ground line equal to the original length of the fteps, and draw AE perpendicular to the ground, and make the fpaces AF, FN, NO, and OE, equal the original height of the rifers. Draw vifuals from each of thefe divifions tending to *s*. Draw FT parallel to AB, and from B and T draw lines to *s*. Next, lay on the ground line the breadth of the ftep, from B to *a*; and from *a* draw a line to *d* the diftance, cutting at *k*; raife a perpendicular from *k*, cutting at *n*; and from *n* draw a parallel to *p*. Then from *p* raife a perpendicular to *q*, cutting the vifual N*s* at *q*; draw a parallel to *r*, and from *r* a vifual to *s*. Then from *a* to *b* lay the breadth of the fecond ftep, and draw a line to *d*, cutting at *m*; raife a perpendicular from *m* to *u*, and draw a line from *u* to *s*, and a parallel from *u* to *w*, cutting the vifual C*s* at *w*. Laftly, lay on from *b* to *e* the breadth of the half fpace, and from *e* draw a line to *d*, cutting at 5, and raife a perpendi-

cular to x, and from x a parallel; which will complete the firſt flight.

The returning ſtep leading to the ſecond flight is next to be conſidered.

For this, draw the perpendicular y, 7, 8, 9, 10, at a diſtance from A equal to the width of the returning ſteps; draw the line 6, 7, parallel to Y A, and at 6 there is an allowance made for the bearing of the ſtep; alſo at Z there is an allowance for the other half ſpace to reſt on. Draw the viſuals R s and E s; and how to complete the reſt of the ſteps muſt be evident from the figure. The returning flight comes forward until it is in the ſame plane with A B, the firſt riſer; therefore, after having placed the original height of the riſers at 8, 9, 10, and drawn from theſe diviſions viſuals to s, it remains only to lay on the bearing of the ſteps at 1, 2, tending to the diſtance, and cutting at 3, 4. Theſe being traced along the ſteps, as ſhewn by the dotted lines, till they cut the viſuals 7 s, R s; how to perform the other part will appear obvious. N. B. The laſt ſtep of the returning flight 10, 12, does not all come into the plate, otherwiſe its length would be equal A B, the original length of the ſtep. Theſe ſteps might have alſo been repreſented oblique to the picture; but as I have not plate-room for ſo many examples, the learner muſt try if he can do it himſelf, by reflecting on

what has already been ſaid and done on objects in oblique ſituations; but if he fail in his attempt, he may conſult Mr. Malton's complete treatiſe, in its practical part.

Example II. Fig. 30. Plate XXII.

How to repreſent a Tuſcan Pedeſtal and Baſe parallel to the Picture.

Draw A firſt, the profile of the pedeſtal and baſe, which is taken from the large module of the Tuſcan order in Plate VIII. Let H L be the horizon, and make *s* the center, and *s d* only half the diſtance of the picture, for want of room on the plate. Make G R the ground line, and on it, from B to C, lay a ſpace equal to the length of the original plinth. Draw from theſe, lines to *s*. Next, conſider how far the pedeſtal is to be repreſented from the picture, which in this example is equal twice C D; becauſe the whole diſtance is equal twice *s d*. Therefore, from D draw a line to *d*, cutting at F. Make D E equal half B C, cutting at I. Draw F K and I O parallel to B C, by which a ſquare will be repreſented equal to the plinth. Proceed now to repreſent the projection of the ogee or baſe of the plinth. For this, take *o*, 1, half the original projection of the plinth, and place it from B to 2. From 2 draw a line to S, cutting at 3; and from 3 draw one to *d*, the diſtance, cutting 4. Draw next

 the

the diagonals K I, F O. From 4 draw a parallel line, cutting the diagonals at 8, 5, and from 5 draw a line to *s*, cutting at 6; then will be projected each miter of the plinth, and alſo the ſize of the dado will be determined at the ſame time. Therefore from 8, 5, and 6, raiſe perpendiculars at pleaſure, which will ſerve both for the angles of the dado and the plinth of the baſe. From *o* draw a line to *s*, which will cut the parallel produced from 8 at 5, and will give an internal miter at 5, K; raiſe perpendiculars from 5, K at pleaſure. From *c* and 12 on the profile, draw lines to *s*, cutting the perpendiculars raiſed from 5, K at *f*, *m*, which will give the correſpondent miter to 5, K. Draw the projecting diagonals of each moulding on the profile, as 9, 10, 11, 12, and draw *a b*; from all which points in the mouldings draw viſuals to *s*, which will ſeverally cut the aforeſaid perpendiculars at *q*, *p*, *n*, *m*, *r*. Draw then the line *m n*, *p q*, whic will be the diagonal lines of the internal miters. Now draw parallels from *p q*, which will cut the perpendiculars at 13, 14, 17. From 14, 17, draw viſuals to *s*, which will cut at 15, 16; and it is evident that by theſe the three miter lines will be correctly determined. From each angle of the mouldings on the profile draw lines to *s*, and afterwards obſerve how the profiles are cut by each projecting diagonal, to which make every perſpective miter agree. For inſtance, draw a line from *v*, the point where the diagonal cuts the upper ſquare of the ogee, till it cut the miter line at *t*; from *t* raiſe a perpendicular ſhewn by the

the dotted line, which will form the ſquare on that miter, from which the ſame ſquare muſt be traced round the dado, as is evident from the figure. In the ſame manner muſt the upper moulding be managed; which, after what has been ſaid, it would be a dull and tedious repetition to go through a deſcription of it. And I am perſuaded, that if the learner cannot comprehend it from what has already been ſaid and done on the figure, he would fail of attaining it after all that I could ſay on it. It remains now to conſider the baſe, with a part of the ſhaft of the column: and this will admit but of very little deſcription, when we ſuppoſe the learner already acquainted with repreſenting ſquares and circles, of which the baſe is compoſed; and if he be not, he muſt turn back to theſe, for it is impoſſible to draw a figure to ſhew all theſe, without confounding the whole. The principal thing to be obſerved in this matter is, firſt, after having drawn *z*, the plinth on which the baſe reſts, on it a circle muſt be repreſented for the bottom of the torus, ſomewhat leſs than the plinth, determinable from the profile; after which the projection of the torus muſt be found, by drawing the lines *b*, *g*, *w*, to *s*, cutting a parallel from the plinth L at *i*, *k*, *b*. Take half *k l* and place it from *x* to *z*, and a line from *z* to *d*, cutting the viſual *x s*, will find the projection of the torus, as the dotted upright line ſhews. Upon this torus muſt be repreſented a ſquare, ſo much leſs as the projection of the torus; in this ſquare a circle muſt be repreſented to guide the top of the torus,

torus, and having already drawn one for its bottom, by theſe it may be completed. Next find the height of the fillet above the torus, which is done by drawing viſuals from the points above x; and by a ſteady hand and good eye the fillet may eaſily be drawn, by following the upper part of the torus. Laſtly, to find the projection of the conge or hollow; take half $k\,l$ and place it from z to y, and direct a line to d, as before, cutting at the ſecond upright dotted line; how the reſt is performed is only to repeat what was neceſſary in repreſenting the other parts of the baſe, and therefore it is needleſs to ſay more, except to obſerve the neceſſity of taking care in drawing the curve lines, ſo that the torus may ſeem to reſt eaſy on its plinth, and not appear to ſtart ſuddenly up, as is commonly the caſe in ſuch repreſentations, when they are drawn by perſons who only underſtand perſpective, but are deſtitute of taſte in drawing.

EXAMPLE III. FIG. 31. Plate XXIII.

How to repreſent a Tuſcan Entablature and Capital parallel to the Picture.

IN the preceding example, the pedeſtal, baſe, and part of the ſhaft, are all under the horizon, conſequently the returns of each moulding ſeem to riſe up; but in the example before

us,

us, every part is above the horizon, and therefore each returning member appears to defcend. Hence this horizontal line is in a reverfe fituation to the other, being under the object as the line H L, and that which we formerly ftyled the ground line, whereon was laid each original meafurement, is now at S P, properly termed a fection of the picture, on which thefe muft be placed. Therefore having drawn Y, the profile of the entablature, taken as before from Plate VIII. Lay on A B the full extent of the cornice, and from A B draw vifuals to *s*; divide A B at E, and draw another vifual to *s*. Confider then how far the entablature is to be reprefented from the picture, which in this example is equal twice E F, becaufe we have only ufed half the full diftance. Draw then a line from F to *d*, cutting at G; through G draw a parallel, cutting at I K, which will then be the front edge of the greateft projecting part of the cornice. And fince the line from F to *d* is in a direction only to half the diftance, it will cut the vifual A D, tending to *s*, in the fame point as it would be cut if a line from K was directed to a diftance twice *s d*; therefore a parallel line from D to C will reprefent a fquare equal to the whole projection of the cornice. It is neceffary for the learner to be clear in this, otherwife he will not know what he is about, nor underftand the fucceeding directions. Having then found this fquare, draw the diagonals K D, I C, which diagonals muft neceffarily give the

proper

proper direction to each miter at the top of the cornice. Take then, from Plate VIII. half the upper diameter of the column, and place it each way from E at M N. Draw from M N visuals to *s*, which will cut the aforesaid diagonals at 1, 2, and 3, determining the seat of the cornice, and the other mouldings. Let fall perpendiculars from the points 1, 2, 3. Proceed now to draw lines from each moulding in the profile to *s* the center; and also from Q draw one to the center. Produce the parallel from 1 to 4, cutting the line Q. From 4 let fall a perpendicular, then will the visual line O from the bottom of the cornice be cut at U. From U draw a parallel, cutting the perpendiculars from 1, 2, at 6, 7; from 7 draw a visual to the center *s*, cutting the perpendicular from 3 at 8. Draw the projecting diagonal O 9 of the profile, and strictly observe how it cuts each moulding. Draw also U 10 of the internal miter. In like manner draw 6, 10, 7, 12, and 8, 13. Now from the internal miter, as at *e*, *a*, *b*, *c*, draw parallels, cutting the other projecting diagonals round the cornice, in the same proportion as that of the profile. Every other particular must be obvious from inspection, after what has been said already on the pedestal.

It now remains to find the representations of the architrave and capital. To do this, take the projections *f*, *g*, *h*, from the profile, and place them from Q at *i*, *k*, *l*, and from these direct

lines

lines to *s*, cutting the miter line near 4, as ſpecified by the points. From each of theſe points let fall perpendiculars to their reſpective viſuals already drawn; that is, from the point neareſt 4 let fall a perpendicular to *m*, from the next point let fall one to *o*, and from the laſt point let fall one to *n*, which will find the internal miter. From each of theſe miters draw parallels at pleaſure, as ſhewn by the figure. Laſtly, theſe parallels muſt be cut, in order to determine the projection of each miter in the repreſentation, which is eaſily done, by the ſame method uſed in the internal miter: thus, from MN lay on each way *i*, *k*, *l*, the ſame as *i*, *k*, *l*, near Q, and direct viſual lines to each miter line at 1, 2, 3. From each of theſe points let fall perpendiculars as before to their reſpective parallels, and each miter will be found, as is evident from the figure. With reſpect to the circular mouldings in the capital, theſe muſt be drawn by firſt finding the ſquares in which they may be inſcribed, and then uſing that freedom of hand and good taſte, which are the beſt and only guides that can be uſed in theſe caſes. And here the learner ſhould be put in mind, that the example before us not only ſhews how to repreſent the Tuſcan entablature, but alſo how to draw broken mouldings parallel to the picture, or how to repreſent a cornice round the inſide of a room. For if the dotted lines drawn from the internal miter were made good and ſhaded, and if thoſe returning to the profile were alſo ſhaded, the effect would then be ſeen.

I ſhould have been glad to have aſſiſted the learner in the repreſentations of the other four orders, but he muſt be ſenſible that it would be impoſſible for me either to find room or time for ſuch an arduous taſk in a work like this, which calls for place and attention to ſo many different articles. It is my opinion, however, that if the learner thoroughly acquaint himſelf with the repreſentation of the Tuſcan order, he will not be at much loſs how to draw the other, except in the capitals of the three laſt orders when they are oblique to the picture. But theſe will rarely, if ever, be wanted by thoſe for whom this work is intended. However, if they ſhould, I will refer the reader to Mr. Malton's work, as the beſt I know of, for their aſſiſtance in this matter.

Example IV. Fig. 32. Plate XXIII.

How to repreſent Arches parallel and perpendicular to the Picture.

First, of arches parallel to the picture.

Let A, B, C, D, be an arched paſſage, whoſe entrance is parallel to the picture, in which caſe the arch is ſimilar to its original; that is, a perfect ſemicircle, as demonſtrated by Fig. 20. Plate XIX. and page 284. Therefore let the line 2, 4, drawn

parallel

parallel to the ground be the diameter, and E the center of the arch; ſweep the arch as in any other circle; draw the viſuals A *s*, B *s*, and make *d* the diſtance. Conſider next the ſize of the pier or pillar on which the arch is to reſt. Let A K be the thickneſs, and draw K *d* cutting at P. Draw P Q parallel to the ground, and raiſe a perpendicular from Q. From 2, 4 at the ſpring of the arch, and from E the center, draw lines to *s* the center of the picture; and the viſual line from 4 to *s* cutting the perpendicular from Q at 3, draw from 3 a line parallel to 2, 4, cutting the viſual E *s* at I; then will I be the center of the furtheſt ſemicircle, which completes the arch, by fixing the foot of the compaſſes in I, extending the other to 3, and ſweeping the arch 1, 3, as the figure ſhews.

EXAMPLE V. FIG. 32. Plate XXIII.

To repreſent Arches in a perpendicular Direction to the Picture.

LET the perpendicular line A 7 be the original height of the arch-way. Draw from 7 a line to the center *s*, and make 7, 8 equal to the ſemidiameter of the arch, and from 8 draw a line to *s*. Next conſider how far the arch is to be from the front of the picture, which is here equal A K. From K

draw a line to *d*, the diſtance, cutting at P; and from P raiſe a perpendicular, cutting at 10. Take 8, 7 equal to the ſemidiameter of the original arch, and repeat it from K to N, from N to S, from which draw lines to the diſtance, cutting the viſual A *s* in O Y. From theſe raiſe perpendiculars, cutting at 11 and *e*; then will *a* be the center of the arch. Draw then the diagonals *a* 11, *a* 10, and divide 9, 10, or 8, 7, into ſeven equal parts, and take two of theſe, as at 12; from which draw a line to *s*, cutting the diagonals, as the figure ſhews by the points. Through theſe points draw, by a ſteady hand, this ſide of the arch. For the other ſide of it proceed in the ſame manner, by drawing viſuals from 2, 13. Laſtly, draw *a c* parallel; alſo 10, 14, and 11, 15; then from *c* to 15 and to 14 draw diagonals agreeing with the other, and cut theſe as before, by a line from 16, by which the other ſide of the arch will be repreſented; that is, as much of it as ought to appear. The part which does not appear is denoted by the dotted curve. In the ſame manner proceed with the ſecond, or with as many more arches as may be wanted, by repeatedly laying on the ground line the original meaſurement at T V.

EXAMPLE

EXAMPLE VI. FIG. 33. Plate XXIV.

How to represent a House in Perspective, having its Front parallel to the Picture.

LET H L be the horizon, and G R the ground line, *s* is the center, and *s d* the distance of the picture. Make A C the original length of the front, from which draw visuals to *s*. Consider next how far the house is removed back, which is here equal C 1. From 1 draw a line to *d*, cutting at 7; and from 7 draw a parallel to 8. Draw a plan of the roof 1, 2, 3, 4. And from *d* the distance, draw *d v* parallel to the side of the roof 1, 2; then will *v* be the vanishing point for that side of the roof. Take *s v* and place it below the horizon at V, perpendicular to *s*; then will V be the vanishing point of the other side of the roof 2, 3. From 8 and 7 raise perpendiculars at pleasure, and make A F the original height of the front. From F draw a line to *s*, cutting at 9; draw a parallel from 9 to 10. For the windows and door, lay their original measurements on A F and A C, drawing visuals to *s*, as the figure shews; and as the front is parallel to the picture, consequently each object on it is similar to their originals*, and therefore lines perpendicular to 8, 7,

* See pages 274 and 275.

and

and 9, 8, will form the fides, tops, and bottoms of each window and door-way. From 9, 10 draw lines to *v*, the vanifhing point of the roof; from 10 draw a line to *s*, the center. Take then 1, 3, the fpan of the roof, and place it from F to B; and from B draw a line to *s*, cutting at 11; from 11 draw a line to V, below the horizon, cutting at 14; from 14 draw a parallel to 13, for the top of the roof; and from 13 draw a line to V, cutting the line 10 *s* at 15, forming the fartheft fide of the roof; draw a perpendicular from 15 to 6, which will complete the end of the houfe. Laftly, to find the height of the chimney, draw a line from *s* through 14, cutting at E; and from E lay on the original height of the chimney to D; and from D draw a line to *s*, cutting a perpendicular from 14, which will give the height required.

Method fecond.—The front of the houfe being drawn as has been defcribed, to find the appearance of the roof and gable-end, draw the roof 1, 2, 3, as before; and from 4 and 3 draw lines to *d*, cutting at 5, 6; from 5, 6 raife perpendiculars at pleafure; from 5 draw a parallel to O, cutting the vifual A *s* at O, for the center of the left gable-end; from O raife a perpendicular at pleafure. Take then the perpendicular height of the roof, from 4 to 2, and place it from F to E; and from E draw a line to *s*, cutting the aforefaid perpendicular at 14, which will give both

the

the pitch and height of the roof. From 14 draw a parallel to 13, cutting the other perpendicular correſpondent with 14. Laſtly, from 9 draw a line to 14, and from 10 draw a line to 13, and from 13 to 15, which will determine the appearance of the roof, as before.

EXAMPLE VII. FIG. 34. Plate XXIV.

To find the Repreſentation of a Houſe whoſe Gable-end is parallel to the Picture.

IN this caſe the front that was before parallel to the picture is now turned perpendicular to it. The gable is therefore parallel to the picture, and is nothing more than a geometrical elevation, found by laying on the heights on *a b*, and the widths on *a f*, and drawing lines from theſe to *s*, the center; *m f* is the diſtance of the houſe from the picture; and a line from *m* to *d*, cutting at *n*, finds the repreſentation of that diſtance. The other lines to the left of *m*, all tend to *d* alſo, by which the windows and doors, &c. are found; *m q* is equal to the original length of the front, a line therefore from *q* to *d* determines its apparent length on the picture. For the pitch of the roof, draw *e s*, cutting at *p*; from which raiſe a perpendicular; draw another perpendicular from *w*, the center of the other

other gable-end; alſo draw the viſuals *k s*, *l s*, for the roof; which viſuals will cut perpendiculars at *h* and *i*, anſwering to the points *l k*, by which the roof is formed. For the reſt, the figure itſelf is ſufficient, by obſerving that *u t* is the perpendicular height of the roof, and *t b* of the chimney.

EXAMPLE VIII. FIG. 35. Plate XXIV.

How to repreſent a Chair, having its Front parallel to the Picture.

AFTER having made a ſcale of feet and inches to proportion each part of the chair by, draw A, the profile of the back and ſide rail; and draw B on the right, according to the bevel of the ſeat; and obſerve, to diſtinguiſh the lines of each chair, one is marked with ſmall letters, and the other with numerals.

Let H L be the horizon proportioned by the ſcale, about five feet high from G R the ground line. Make *a b* equal to the length of the front; from which draw lines to *s*, the center, which, in general, ought to be perpendicular over the middle of the chair, becauſe it affords the moſt eaſy and natural view of its back. Next, from *q*, the width of the ſeat, draw a line to the diſtance, here out of the plate, cutting the viſual *a s* at *c*;

8 from

from *c* draw a parallel to *e* at pleaſure. Take CD, the bevel of the ſeat, and place it from *a* to *d*; and from *d* draw a line to *s*, cutting *c e* at *y*, which gives the bevel of the ſeat. From *a* draw a line through *y*, cutting the horizon at V, which will be the vaniſhing point to every line originally parallel to *a y*, the ſide rail; take *s* V and place the ſame ſpace to *v*, which will be the vaniſhing point to the other ſide of the chair; therefore from *b* draw a line to *v*, cutting at *e*, which forms the ſeat. For the thickneſs of the back rail, draw a line from *p* to the diſtance, as the figure ſhews. For the height of the back, raiſe a perpendicular *a g*, and draw a parallel from *r* to *g*; draw alſo a perpendicular from *y*, and a line from *g* to V will cut it at *f*, determining the height of the back. For the bottom of the back foot, draw a line from *u* to the diſtance, cutting a perpendicular from *c* at *w*. From *w* draw a parallel, and from *z* draw a line to the vaniſhing point V, cutting at *x*, which will determine the place of the back foot*. How every other part is done, muſt be evident from inſpecting the figure.

* The reader will perceive that the line from *z* to *x* is not accurately drawn, for the engraver did not follow his copy, otherwiſe the line would have touched the bottom of the back foot tending to V, which the learner may prove, by drawing a line from *z* to V. This inſtance may ſerve to ſhew the trouble there is with engravers, who in general are totally ignorant of perſpective.

Example IX. Fig. 36. Plate XXIV.

How to repreſent a Chair having its Front perpendicular to the Picture.

In this example the ſame ground line, horizon, center, and diſtance, is uſed as in the preceding; therefore let the ſpace 7, 1, be equal to the length of the chair front. From 7 draw a line to *s*, and from 1 draw a line to the diſtance, cutting at 16. Make 7, 9 equal to the length of the ſide rail, and from 9 draw a line to *s*; make 9, 10 the thickneſs of the back foot, and from 10 draw a line to *s*, as before. Draw a parallel line for the depth of the ſide rail, and from 8 draw a line to *s*. Next conſider how much the back foot ſweeps off from the perpendicular, which is equal to the ſpace 12, 13, or 2, 22; draw viſuals from each of theſe points, as the example directs. To find the bevel of the ſides, take C D and place it from 7 to 5, and from 1 to 3; from which draw lines to the diſtance, cutting at 11 and 17; from 11 and 17 draw parallels cutting the viſual 9 *s* at 20 and 18; from 7 draw a line to 20, and from 16 draw one to 18, which will finiſh the outline of the ſeat. Laſtly, from 18 and 20 let fall perpendiculars, cutting at 24, 25; from which draw parallels to the viſual 13 *s*, which gives the bottom of

each back foot; and for every other particular, a little reflection and obſervation will be ſufficient.

EXAMPLE X. FIG. 37. Plate XXV.

How to repreſent a round Table in Perſpective, having two of its Claws in front parallel to the Picture.

DRAW a profile of the pillar and claw, as at A. Take *a b*, the ſpring of the claw, from the center of the pillar, and with it deſcribe a circle 1, 2, 3; divide the circle into three equal parts, ſo as to ſuit the intended poſition of the claws, as 1, 2, 3; draw from theſe perpendicular lines to *i*, *e*, *f*. Repreſent a ſquare 4, 5, 6, 7, equal to the diameter of the top; draw the diagonals and diameters of the ſquare, and from *i f* draw viſuals to *s*; from C, the center, draw a perpendicular for the pillar; and having determined the height of the table at B D, from B D repreſent a circle for the top, as has been taught in page 289, ſee Fig. 23. Next find the place of the claws; for which make *f e* equal *f* 2, and from *e* draw a line to the diſtance *d*, cutting at *g*; from *g* draw a parallel to *b*, for the other claw. To find the place of the back claw; extend the compaſſes from *e* to 3, and make 4 *c* equal to it; from *c* draw a line to the diſtance, cutting at *m*; and from *m* draw a parallel to *i*, which will be the place

 of

of the claw. For the different parts of the pillar, draw from the profile lines to the diſtance, cutting the perpendicular C F, as the figure ſhews. It now remains for every part to be finiſhed by a good hand and eye accompanied with judgment, as no other rules can be of any ſervice in caſes of this ſort.

EXAMPLE XI. FIG. 38. Plate XXV.

How to repreſent an octagon Table having one of its Claws in Front perpendicular to the Picture.

DRAW the profile of the pillar and claw, as at B; and, as in the other example, take the ſpring of the foot or claw from the center of the pillar, and with it deſcribe a circle, and mark out the place of the claws at 1, 2, 3. Draw 1, 2, 3 up to the ground line, and produce 1 up to *u*, for the height of the table. Repreſent a ſquare both at top and bottom, and draw the diagonals, finding the center for the pillar. Draw now the dotted lines from the profile to *u* the perpendicular, and where they cut draw lines to *s*, the center of the picture, cutting the center of the pillar for each reſpective moulding. Next find the ſituation of the claws; having drawn lines from *k*, *b*, *a*, to *s*, make *b b* equal *b i*; and from *b* draw a line to the diſtance, cutting at *g*, which will be the place for the firſt claw. Make *a c* equal *a* 3, and from *c* draw a line to *d*, as before, cutting at *b*; from *b* draw

draw a parallel to *e*, then will *b e* be the place of the two other claws. From 5 and 4, produced from 7, the height of the toe, draw lines to *s*; and from *e* and *b* raiſe perpendiculars cutting theſe, which will be the height of the toes of the back claws. Laſtly, we here ſuppoſe the top to be an irregular octagon, wherefore let *m n* be equal to four of its ſides; draw from *n m* lines to *s*, from *n* draw a line to *d*, cutting at *o*; from *o* draw a parallel to *t*; finding the oppoſite angle, draw *m t*; and from the diſtance draw a line through *w*, cutting at *r*; from *r* draw a parallel to *p*; and draw *p q*, which will finiſh the octagon for the top.

EXAMPLE XII. FIG. 39. Plate XXV.

To put a Commode Table in Perſpective, having its Front parallel to the Picture.

OBSERVE, the ground line for the tables is here uſed as the horizon for the commode.

Make *s d* half the diſtance, for want of room on the plate, and make G R the ground line. Draw then the plan P of the front, according to the intended ſcale. And, in cutting of each viſual line, uſe one half of a foot inſtead of a whole one; becauſe only half the whole diſtance is uſed. Therefore, having drawn

drawn the viſuals 3 *s*, B *s*, draw a line from 1 foot on the ſcale line to *d* the diſtance, cutting at *g*; then will 3 *g* repreſent a line two feet long, equal to the breadth of the commode. From *g* raiſe a perpendicular, cutting at *m*, finding the apparent width of the top; draw 5, 10 parallel and equal to the height of the foot and bottom of the commode; draw parallel lines, alſo, for the partition below and above the drawer, and for the top, as ſhewn by the figure. Proceed now to find the place of the feet and the ſweep of the front: for the feet take half 3, 4, and from 3 place it to 6; from which draw a line to *d*, cutting at 2; from 2 draw a parallel cutting B *s*, for the other foot. Find now two points by which to direct the ſweep of the front thus: draw perpendicular lines from the plan at 9, 12, and from 13, *i*, *k*, where they cut, draw lines to *s*; then take half 8, 9 and place it from *k* to *i*; and from *i* draw a line to *d*, cutting at *p*, finding a point for the curve; from *p* draw a parallel to *t*, finding the oppoſite point, which will be ſufficient for the whole. Laſtly, for the receſs draw viſuals from *r f*, and, ſuppoſing the receſs to be a foot deep from front, make *e f* equal half a foot on the ſcale; draw from *e* a line to *d*, cutting at *o*; and from *o* draw a parallel to the oppoſite viſual. Every other thing may be learned by obſervation, without going through a minute detail of every particular, which would become an exceeding dry taſk indeed.

EXAMPLE

Example XIII. Fig. 40. Plate XXVI.

How to represent a Chair obliquely situated to the Picture.

In the two former examples of chairs in perspective, the first of these had its front parallel to the picture, which is the most usual way of representing a chair when it is wanted to be viewed as a pattern; for the back being parallel also, it gives the most natural and distinct view of the banister and all its parts. The second is put with its front perpendicular to the picture, which is a position wanted in the representation of internal views of rooms or passages: and this third example being put oblique, is considered by painters most picturesque or suitable for a picture, in which case the pattern of the chair is not much regarded, only its unformal situation suiting to the subject and circumstances of the design. In this example I shall therefore consider myself as offering some assistance to the painter, as well as in a few other instances in this book.

Observe, that the vanishing points v V, and measuring points m M, of this example, are all found by laying the distance downwards to D, for want of room on the plate, and which needs not here be explained, after what has been done

in

in problem VI. page 236, as it makes no difference whether the diſtance be above or below the horizon. Therefore proceed in conſidering G R the ground line, drawn parallel to the horizon H L; on G R make a ſcale of inches to proportion every part by. Make *a f* equal to the original length of the front, which in parlour chairs is generally 21 or 22 inches; and let *a g* be equal to the width of the ſeat from the inſide of the back to the front, commonly 16 inches. As *a* is conſidered the neareſt angle to the picture, from *a* raiſe a perpendicular at pleaſure, on which the original heights of each part muſt be laid, as from *a* to *m*, for the height of the ſeat rail, about 16 inches without the ſtuffing. From *a* and *w* draw viſuals tending to V and *v*. From *f c* draw lines to *m*, cutting at *x y*; from *b* do the ſame, cutting at 3; from which points raiſe perpendiculars for each foot. Next, from *g* draw a line to M, cutting at *k*; from which raiſe a perpendicular to *o*; from *o* draw a line to V; and from 4, the inſide of the front foot, whoſe thickneſs is ſuppoſed equal to the bevel of the ſide rail, draw a line to *v*, cutting at *p*; then from *w*, the outſide of the foot, draw a line to *p*, produced till it cut the horizon at *o*, which will be the vaniſhing point to every line originally parallel to the ſide *w p*. From *v* extend the compaſſes to *o*, which lay on to O, and O will be the vaniſhing point to all lines parallel to the other ſide *t* 5. Therefore, from *t* draw a line to O, which will cut at 5, completing the form of the ſeat. On the perpendicular line from *w*, lay

lay on 21 inches for the height of the back, and direct a line to *o*, and through *p* draw a perpendicular at pleasure for the joint of the side rail. Next consider how much the back foot pitches, which in this example is equal *b g*, and *b i* is for the thickness of the toe. From these draw lines to M, cutting at *k*, *l*, *n*; and from *k*, *l*, *n*, draw lines to V, which will cut the visual *b v* in the place for the toe at 8, 6; from 6 raise a perpendicular cutting at 7, and from 7 direct a line to V, for the top rail; and how the rest is performed must be obvious from what has already been said and done.

EXAMPLE XIV. FIG. 41. Plate XXVI.

To put a Cylinder Desk and Book-case in Perspective, having its Front oblique to the Picture.

DRAW first an elevation of the cornice and pediment, and proportion the pediment according to Fig. 36, Plate V. by dividing half the length of the cornice into nine equal parts, of which take four for the pitch. Take one of these parts for the height of the pedestal, and the remaining three for the vase. Draw lines up to the ground line at *q*, *r*, F, *p*, *f*, and the vanishing points having been already found, draw from *r* lines tending to each; from *r*, the nearest angle of the book-case, raise a

 perpendicular

perpendicular at pleaſure, on which the ſeveral heights muſt be laid. From *r* to A lay on the depth of the lower part, and direct a line to M, cutting at U, and make A B the depth of the book-caſe, and draw a line as before, cutting at X, from which raiſe a perpendicular. In the ſame manner draw lines from F *p*, tending to *m*, and cutting at 3, 12, for the length and center of the book-caſe. The ſeveral original heights for the deſk part, doors, and cornice, muſt now be placed on the perpendicular, from which lines muſt be drawn to each vaniſhing point. And here we muſt obſerve, that as the neareſt angle of the book-caſe comes forward to the picture*, conſequently the ſlider is on this ſide of it. To project the ſlider in this caſe, a vaniſhing point muſt be found, from which, if a line be directed it will paſs through the diagonal of any ſquare. Thus: on D, the diſtance, ſweep the arch S, and biſect it at S, and through S direct a line to the horizon, cutting at *d* on the ſmall drawers; lay from *r* to *g* a ſpace equal to the projection of the ſlider; and from *g* direct a line to *m*, cutting at *i*; from *i* raiſe a perpendicular to *y*; and from *d*, the aforeſaid vaniſhing point, draw a line through *y* at pleaſure; and from *v* draw a viſual for the end of the ſlider, cutting at *n*; from *n* draw a line to V, and from *v* draw one through 10, for the other end of the ſlider. The opening of the door is next to be conſidered. It is evident

* When any object is repreſented to touch the ground-line, that part which touches it is ſaid to be in the picture.

that

that a door turning on its hinges muſt deſcribe a ſemicircle, and therefore if a ſemi is repreſented, whoſe radius is equal to the breadth of the door, its circumference will determine any opening that can be propoſed.

To deſcribe the ſemicircle proceed thus.—From the vaniſh-point *v* draw a line through *z*, the center of the book-caſe, and produce it at pleaſure; then from *d*, the vaniſhing point of any diagonal, draw a line through 12, cutting at C; from C draw a line to V; and from *v* draw a line through 12, cutting at K; and from K draw another diagonal to *d*, cutting at *w*; from *v* draw a line through *w*, cutting at E, and produced to Q, cutting a parallel from C; from 12 to E draw a diagonal, and if the door is intended to be opened 45 degrees more than ſquare, produce this diagonal, as ſhewn by the dotted line, till it cut the horizon, and its interſection with it will be the vaniſhing point for the top and bottom of the door. Divide C Q into ſeven equal parts, and from one of which at 7 direct a line to *m*, cutting at 13; and from 13 draw a viſual to *v*, cutting at 1; from 1 draw a viſual to V, cutting the other diagonal at 2; from 2 raiſe a perpendicular for the apparent breadth of the door in this poſition; and from the laſt mentioned vaniſhing point found by the dotted line, draw lines for the top and bottom of the door, by which it may be completed. For the ends of the cylinder we need not ſay any thing, as this is the ſame as in pro-

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blem XXII. therefore we ſhall proceed with the cornice and pediment.

Set off the projection *q r* of the cornice at 6, 5, on a parallel line drawn at the full height of the book-caſe, and draw lines to *v*, and the line 5 will cut the perpendicular raiſed from X, and the line 6 will cut a perpendicular at 8, ſuppoſed to be raiſed from *t*, the miter point of the cornice, which is found by drawing a line from *d*, the vaniſhing point of the diagonal to X, cutting at *t*; from *t* direct a line to V, cutting at *a*; and from *a* raiſe a perpendicular, which will cut a line drawn from 8 to V, at the other miter point; every other part of the cornice muſt be finiſhed by the reader's judgment, governed by theſe principles, as it would be impoſſible to apply every rule in ſuch ſmall examples.

Laſtly, for the pitch of the pediment, a vaniſhing point muſt be found, according to the principles in Problem IX. Plate XVI. by drawing a line from *m* parallel to the pitch line at the elevation P, produced to V P, cutting a perpendicular from V; from 8 draw a line to V P, cutting a perpendicular in the center of the front edge of its cornice; from which draw the other ſide of the pediment, which, if produced, would cut a point as much below the horizon as V P is above it. Theſe pitch lines being found, the ſcroll pediment may be drawn by hand with

ſufficient accuracy; but if the pediment be a ſtraight pitch, then the lines for each moulding muſt tend to V P, and to a point as much below the horizon. And I would here obſerve, that in drawing after theſe examples, it is not intended that the diſtances made uſe of in them ſhould be a precedent to the learner. Theſe are choſen to ſuit the plate; but the learner having ſufficient room on his drawing-board, muſt chooſe his diſtance to give the moſt natural and pleaſing effect to his drawing, by the rules already laid down. See page 275.

In theſe examples almoſt every difficult part of perſpective is introduced, and it is preſumed that, after the learner has made himſelf fully maſter of them, nothing will occur in practice that can give him much trouble, eſpecially if he be properly acquainted with the ſhort theory that has been given. However I am fully perſuaded, that no cabinet-maker or upholſterer will ever want to practiſe more; and, if I am not miſtaken, there are but very few painters who are at the trouble of practiſing ſo much. But if the reader's profeſſion or neceſſities ſhould require him to extend his ſkill in this art further than what has been advanced in this treatiſe, I will freely refer him to Mr. Malton's complete Treatiſe, from which, it is here gratefully acknowledged, I have received conſiderable aſſiſtance.

SECTION VI.

Containing a ſhort View of the Nature and Principles of Shadows, cauſed by the Sun coming in different Directions to the Picture; together with ſome Remarks on the Effect of Light and Shade in general.

WHAT has hitherto been done in the foregoing ſections is termed by artiſts linear perſpective, which propoſes rules for drawing the outlines of objects in every ſituation, proportioned one to another according to their magnitude and diſtance from the picture; but the ſubject of the preſent ſection is to propoſe rules for giving effect to theſe outlines, by the different circumſtances of light and ſhade. The mere outlines of a drawing is but as a ſkeleton without fleſh or life, but by the addition of proper light and ſhadow, we may almoſt behold nature in a picture: and that which before appeared flat and inſipid, now obtains the force and effect of the objects themſelves.

The doctrine of light and ſhadow may be conſidered under three heads. As,

Firſt, when the force of the ſun's rays fall on objects, and thereby produce a ſhadow ſtrongly defined.

Secondly,

Secondly, When the ſun is not ſuppoſed to ſhine, and the ſhadow is only produced by light ſimply conſidered, or by reflection.

Thirdly, When the light or ſhade of one object is proportioned with that of another at a greater diſtance in the ſame picture. This is termed the aerial part of perſpective, or the diminution of tints according to the diſtance of objects.

The firſt of theſe heads is, however, that which principally concerns us, it being reducible to ſtrict rules; the ſecond follows of courſe; and the laſt can only be learned by obſervation and practice.

In conſidering the ſhadows cauſed by the ſun's rays we may obſerve the following diſtinctions.

Firſt, When the ſun's rays are in the plane of the picture, or, which is the ſame thing, when they are conſidered parallel to it.

Secondly, When the rays come from behind the picture. And,

Thirdly, When they have their direction from the front of the picture.

CASE I. FIG. 42. Plate XXVI.

To project the Shadows of Objects, in various Positions when the Sun's Rays are parallel to the Picture.

THE ſun, which is the great ſource of light, being at an immenſe diſtance from the earth, the rays of light iſſuing from it in right-lined directions, are conſidered as parallel to each other. The truth of this is proved by the parallel ſhadows which it always produces on a plane from objects which are parallel to each other and of equal thickneſs.

When, therefore, the rays are conſidered as parallel to the picture, the ſhadows of all objects are found by parallel lines paſſing by the angles of each object, and in ſuch a degree of inclination as the ſun is ſuppoſed to be in, either to the right or left of the center of the picture. Theſe lines, repreſenting the ſun's rays, being cut by lines from the baſes of each object drawn parallel to the ground-line, find every ſhadow in this caſe.

The learner will recollect, that in ſtating the theory of lines parallel to the picture in page 215, it is there ſaid, "Lines "which are parallel to the picture can have no vaniſhing line

or

" or point in it, because if infinitely produced would never " cut it." The same holds good in the theory of shadows when the sun's rays are parallel to the picture; for then they cannot cut it, and consequently a vanishing point is not wanted in this case.

Hence the shadows of all lines perpendicular to the ground are drawn parallel to the ground line; and as, in perspective, all lines perpendicular to the picture vanish into its center, so likewise the shadows of every such line will tend to it. Therefore,

Example I. Fig. 42

Suppose A to be the representation of a wall perpendicular to the ground and to the picture, R R is a ray from the sun inclining to the left in an angle of forty-five degrees, therefore the shadow 2, 3 of the perpendicular line 1, 2 is equal in length to the line itself. Draw the other ray *r r* parallel to R R, and the shadow *r o* will be equal to the height of the wall *o r*. The line 1 *r* is originally perpendicular to the picture, and vanishes in *s*, the center; so is its shadow 3 *r*, which likewise tends to it.

Example II. Fig. 42.

Suppose EB an object any where on the ground, whose sides EB are oblique to the picture. Draw through each angle a ray *r r* parallel with RR the given one, and draw lines from the foot of each perpendicular, as 4, 6, parallel to the ground line, and their sections with each other will form points for the outline of the shadow. Lastly, from the point 5 draw a line to 7, and from 7 draw one to 8, and filling it up, the shadow will be completed.

Observe, the line 4, 9, and its parallels, are not perpendicular to the picture; therefore its shadow line 5 7 does not tend to *s* the center, but to the same vanishing point necessary for drawing the side B. In the same manner the shadow line 7 8 vanishes to the point requisite for drawing the side E.

Example III. Fig. 42.

Let D be an object having the side D inclined to the horizon, and the other sides oblique to the picture. Draw a ray through *b*, and through *f* parallel to the given ray RR; from *g* the foot of *b*, and from *d* the foot of *f*, draw lines parallel to the ground

ground line, which will interſect the rays at *a* and *c*. To complete the ſhadow, draw a line from the extremity of the inclined plane to *a*, and from *a* to *c*.

EXAMPLE IV. Fig. 42.

LET F be the ſtump of a column reſting on one end, whoſe ſhadow is required. Find the diameter of the column each way, both at top and bottom, as the figure ſhews; and through the extremities of theſe diameters draw parallel rays as before. Laſtly, from the foot of each perpendicular falling from the center and diameter, draw lines parallel to the ground line, cutting the rays at *v*, *w*, *x*; draw a curve to paſs through theſe three points, and the ſhadow will be projected.

Thus it is evident how eaſy a matter it is to project the ſhadow of any kind of object when the rays are parallel to the picture, and when the ſhadow is to fall on the ground plane, as in the foregoing examples.

It is, however, ſometimes neceſſary to project ſhadows falling on other objects contiguous to thoſe whoſe ſhadows are required. Therefore,

Example I. Fig. 42.

Suppose the object D ſtanding in the way of the ſhadow of A, a plane of rays paſſing by the end 1, 2 of the wall, will make a ſection of D at *t*, *i*, 3; which is found by drawing the line from 2 through to 3, and from 3, where it cuts the ray R R, raiſe a perpendicular to *i*, and from *i* draw a line to *t*, which will determine how far the ſhadow comes in front. Laſtly, the baſe line *t d*, of the object D, cuts a line from 3 at *e*; therefore, from *e* raiſe a perpendicular correſponding with 3 *i*, and from *i* draw a line to the aforeſaid perpendicular, and the ſhadow, ſo far as it affects the inclined plane D, will be found.

Example II. Fig. 42.

Suppose the object C near ſome inclined plane G, whoſe ſhadow falls upon it. To find the ſhadow, draw a line *b* to G, parallel to the ground line, at pleaſure; draw then a ray, as before, cutting at G, where the ſhadow would have terminated if the inclined plane had not been there; draw *m l* parallel to *n o*, cutting the ray at *p*; do the ſame at the other end, and the ſhadow will be completed.

Before

Before I enter upon the other cafes of fhadows, I would here remark, that this which has now been exemplified is, in my opinion, the moft ufeful, as well as moft eafily practifed. Particularly it is the moft ufeful to the cabinet-maker and upholfterer, who only want it for fhading different pieces of furniture; becaufe the fhadows thus projected will be to the right or left of the piece, according as the light is fuppofed to come in; but in the two following cafes of the fun's rays, the fhadows will be projected either behind, or on the front of the piece of furniture, which fituations of fhadow are liable to the following objections.

Firft, if the rays come from behind the picture, the front of the piece will be all in fhadow, and confequently the effect of diftinctnefs of parts, which is always expected in furniture, will be deftroyed.

Secondly, if the rays come on the front, then the fhadow will be behind the piece, and therefore little or none of it will be feen, unlefs the point of light be taken very low, which is not very agreeable. Befides, the light coming thus ftrong on the piece, leaves a glare on the front that does not produce a pleafing effect in furniture, nor fufficiently diftinguifhes the front from the white ground of paper on which it is generally drawn.

Painters, indeed, are ſaid to make this laſt-mentioned poſition of light to the picture their choice, becauſe, I ſuppoſe, it clears their picture from the appearance of long black ſhadows, which would frequently look too harſh, and introduce confuſion, as is the caſe when the light comes in from behind. Yet as every caſe of ſhadowing may be neceſſary at times, though not out of choice, I ſhall therefore proceed to the ſecond caſe propoſed.

CASE II. FIG. 43. Plate XXVI.

To project the Shadows of Objects when the Rays come in a Direction from behind the Picture.

WHEN a ray of light comes in a direction not parallel to the picture, it will neceſſarily cut it in ſome point in the horizontal line, or vaniſhing line of the ground plane; for the ſun being at an immenſe diſtance, and the plane of the horizon being conſidered as infinitely extended, we may ſuppoſe a perpendicular let fall from the place of the ſun will touch ſomewhere on the horizon. And hence, the point where it touches the horizon is the vaniſhing point of the ſhadows, and conſequently a line drawn through the ſaid point perpendicular to the horizon will be the vaniſhing line of the ſun's rays; and any where on this line, if a point be fixed according to the ſuppoſed

altitude of the ſun, it will be the vaniſhing point of thoſe rays.

Thus:—in Fig. 43, the center and diſtance of the picture remaining the ſame as when uſed for drawing the cube, let it be required to find its ſhadow when the ſun's inclination to the left is thirty-two degrees, and when its altitude is forty-five. From *d*, the diſtance, draw the line *d b*, inclining from the perpendicular *s d* in an angle of thirty-two degrees; and through *b* draw S S perpendicular to the horizon; then will S S be the vaniſhing line for the ſun's rays. Make *b* M equal *b d*, and from M draw M S, making an angle with the horizon equal to forty-five degrees; then will S above the horizon be the vaniſhing point of the rays when the ſun comes from behind the picture, and S below it will ſupply its place when the rays come on the front. From the vaniſhing point *b* of the ſhadow draw lines through the angles 1, 3, 8, of the cube; and from S draw lines through its upper angles 2, 4, 9, interſecting the lines drawn from *b* in the points 5, 6, 10; from the point 5 draw a line to 6, and from 6 a line to 10, which completes the ſhadow.

Obſervations on the Theory of the above Figure.

The rays S 6 and S 10, forming a triangle, may be conſidered as a plane of rays paſſing by the angle 4, 9 of the cube, and

and being ſtopped on the ground plane at 6, 10, occaſions a ſhadow up to the cube, which ſhadow will vaniſh in the line 6, 10, to V; becauſe the angle or line 4, 9, which projected it, was drawn to, and vaniſhes in V; conſequently a line from V to S, the ſuppoſed place of the ſun, will be the vaniſhing line of the ſaid plane of rays. The ſhadow on the other ſide is compoſed of two lines, becauſe it is projected by two lines in different poſitions to each other. Thus the line 2, 4, originally parallel to the horizon and to the ground, projects the ſhadow line 5, 6 by the plane of rays 5, S, 6; which ſhadow line 5, 6 will vaniſh in V, becauſe the angle or line 2, 4 vaniſhes there. The ſhadow line 5, 1 is projected from the perpendicular line 1, 2 by the plane of rays 5, *b*, S, paſſing by the angle or perpendicular line 1, 2, and therefore the ſhadow line 5, 1 will vaniſh in *b*, the ſeat of the luminary on the picture; through which a line S S paſſing in a perpendicular direction to the horizon, anſwerable to the perpendicular ſides of the cube, is the vaniſhing line of the plane of rays 5, S, *b*, in the ſame manner, and for the ſame reaſon, as the horizontal *v* V is the vaniſhing line of the ſhadows of lines originally parallel to it. The vaniſhing line S S of the ſun's rays may be ſuppoſed to move along the horizon anſwerable to the ſun's inclination to the right or left of the center of the picture *s*, whether the ſun be ſuppoſed on this or that ſide of the picture, or, as we conceive of it by the figure, whether it be above or below the horizon. Hence, if a plane

of

of rays be ſuppoſed to come from behind the picture, in a direction perpendicular to it, the place of the ſun will be ſomewhere on a perpendicular line drawn through the center of the picture, as S *d*. And this place of the ſun, or, which is the ſame thing, the vaniſhing point S, of its rays, will be above or below the horizon, according to the ſuppoſed altitude of the ſun. If, therefore, we imagine the ſun's altitude to be as before, its place will be at *d* when the ſun is behind the picture, and at S when it is before it; and the vaniſhing point of the ſhadow will be at *s*, the center of the picture. This is evident, for the angle V, *d*, *s*, is the ſame and equal to M, S, *b*. In both caſes the ſines *b* S, *o d*, of the angles of the ſun's altitude are the ſame, being equal to the diſtance *s* V of the picture: for, in the ſhadow of the cube, when the plane of rays from behind the picture cut it in the oblique direction of the line *d b*, the line *d b* is then conſidered as the diſtance of the picture, and being turned up to S, is equal to the diſtance of the place of the ſun above the horizon. And ſuppoſe the rays to come to the picture in the direction of *d v*, then *b* would be moved to *v*, and *v d* would be equal to the diſtance of the picture; and being turned up to *v* S, S would then be the place of the ſun, or the vaniſhing point of its rays, and *v* the vaniſhing point both of the ſhadow and ſide of the cube 2, 4. In which caſe we ſhould only have the ſhadow of the ſide 4, 9, 3, 8.

It is further obſervable, that as the ſun may be ſuppoſed to move in a circle, and if that circle be deſcribed by a radius equal to the diſtance of the picture, we may ſhow the different ſhadows of the ſun upon objects at the various times of the day.

Thus:—in Fig. 44, ſuppoſe a line drawn from E W forming the horizon; from the center *s* deſcribe a circle with the diſtance of the picture, and through *s* draw a line perpendicular to the horizon, and M will be the place of the ſun at noon. Now let it be required to find the morning ſhadow of the rod *a* when the ſun has riſen 40 degrees above the horizon, as at 40° S. From 40° S let fall a perpendicular to the horizon at *b*, and draw it through to the other ſemicircle; from *b*, the vaniſhing point of the ſhadow, draw lines paſſing by the bottom of the rod at pleaſure; and from 40° S, the place of the ſun, draw a ray through *a*, the top of the rod, cutting at 1; which ſhews the length of the ſhadow required. Suppoſe the ſhadow of the ſame rod be wanted at noon, *s* will then be the vaniſhing point of the ſhadow, and M the vaniſhing point of the ſun's rays, and the length of the ſhadow will be at 5. Again, if it be required to find the ſhadow of the ſame rod after the ſun has paſſed the meridian 50 degrees, this will bring the ſun to the ſame degree in the afternoon as it was in the morning; and by drawing lines

in

in the ſame manner as in the morning, the ſhadow in the afternoon will be at 2.

Now, if the ſun be conſidered on this ſide the picture, the ſhadows of the ſame rod *a*, at theſe different periods of the day, will be reſpectively beyond the rod at 3, 4, 6, towards the horizon; which is done by tranſprojecting the place of the ſun to S M S, and drawing rays from the top of the rod to each place of the ſun. Thus: from *a* draw the dotted line to S on the left, cutting at 3, and 3 will be the length of the morning ſhadow; and from *a* draw the dotted line to S on the right, cutting at 4, which will be the evening ſhadow. Laſtly, a dotted line from *a* to M, cutting at 6, will be the ſhadow at noon, which is hardly ſeen on the picture. Thus we ſee that the ſhadows of a morning or evening view are long, tending oppoſite ways; and thoſe of a view repreſenting noon-day are ſhort, tending from ſouth to north, nearly ſo. But if we lived in a meridian on the line, then it is evident that at noon there would not be the leaſt ſhadow of objects of equal thickneſs ſtanding perpendicular on the ground: for, ſuppoſe the rod *a* moved into the line M M, then the object would be in the ſame plane with the rays of the ſun; and being directly under it, of courſe all ſhadow would be excluded excepting ſuſpending objects, as No. 2, and thoſe ſupported like tables; in which caſe the rays *r r* falling perpendicular to the

ground, and parallel to each other, on account of the ſun's great diſtance, they would form a cylinder, of which the ſhadow would be a parallel ſection, and therefore muſt be perfectly ſimilar to the object itſelf, both in magnitude and form, as muſt be evident from the figure, and a little reflection on the foregoing principles.

CASE III.

To find the projections of Shadows when the Sun's Rays come on the Front of the Picture.

HAVING already explained the theory of this in what has now been advanced, it remains only to give an example or two to illuſtrate it.

EXAMPLE I. FIG. 45. Plate XXVI.

When the Shadow falls on the Ground.

IN Fig. 45, A is a priſm whoſe ſhadow is projected by the ſun as above propoſed, *b* is the vaniſhing point of the ſhadow, *v* of the ſide of the cube, and S of the rays. Therefore from the angles 1, 2, 3, draw lines to *b*; and from 4, 5, 6, at the top, correſponding with theſe, draw lines to S, cutting at 9, *c*, *b*;

 from

from *b* draw a line to *c*, and from *c* to 9, which, when filled up, will complete the ſhadow.

EXAMPLE II. FIG. 46. Plate XXVI.

When the Shadow falls at the ſame Time on upright, oblique, and horizontal Planes.

THIS figure having the moſt neceſſary lines for repreſenting the two houſes, as well as for finding the ſhadow of one houſe falling upon the other, may be conſidered as an example both of perſpective and of ſhadow. And as the lines for both are here joined together in one view, it will ſhew their relation, and the neceſſary dependence they have on each other; which, it is preſumed, will contribute more to the learner's advantage, than if many examples of ſhadowing had been added without regard to the perſpective lines.

The horizon and ground line being drawn, fix the center of the picture as uſual; from which raiſe a perpendicular as to *d*. Make *d* the diſtance of the picture, and, according to the obliquity ſuitable for the front of the houſe, draw a line to V, for one vaniſhing point; next draw V *d*, and from *d* draw a line to *v*, at right angles with V *d*; becauſe the end and front of the houſe are originally at right angles to each other. Make *v* M equal to *v d*, and whatever angle the pitch of the roof makes, produce

produce a line from M equal to that angle, continued till it cut a line perpendicular to *v*, as at V; then is V the vaniſhing point for the ſide of the roof of both houſes, and a line from V to V will be the vaniſhing line of the plane which the roof is in, and H will be the vaniſhing point of ſhadows lying in the ſaid plane; and producing V V at pleaſure, and meeting it in *o* at Fig. 44, by a parallel from S, *o* will be the vaniſhing point of the ſun's rays on that plane. Extend the compaſſes from V to *v*, and place it below the horizon, and that point will ſerve for the other ſide of both roofs. The houſes being completed in their outlines, according to theſe vaniſhing points, proceed to ſhade them upon a ſuppoſition that the light comes on in the front of the picture, and in a direction from the left hand parallel to the dotted line *d b*. Therefore the point *b* will be the vaniſhing point of the ſhadows falling upon the ground plane, and producing *b* perpendicular to the vaniſhing line V V, H will be the vaniſhing point as aforeſaid. The place of the ſun S is fixed very low, not as a precedent, but that it might throw the ſhadow of the firſt houſe on the ſecond, affording an occaſion of ſhewing the nature of ſuch ſhadows.

From *g*, the pitch of the roof on the gable-end, draw a line to S; and from *a* draw a line to *b*, which will cut the front of the other houſe at *o*; from *o* raiſe a perpendicular, cutting the line drawn from *g* to *b* in *e*; from *e* direct a line to V, the vaniſhing

niſhing point for the fronts of each houſe, which gives the ſhadow for the roof. From the tops of each chimney draw lines to S, and obſerve that the ſhadow of the firſt chimney falls partly on the roof, becauſe the ray drawn to S cuts the roof, and that ray muſt be cut again, by drawing a line from the top of the perpendicular ſhadow *o e* to H, the vaniſhing point of ſuch ſhadows as fall on the roof, and from the top of the ſhadow on the roof direct a line to *o*, in Fig. 44, which gives the complete ſhadow of the chimney. Laſtly, from *b*, at the bottom of the ſecond houſe, draw a line to *b*; and cut that line by two others, one from the top of the chimney, and another from the pitch of the roof, as before; from theſe interſections draw lines to V, the vaniſhing point of the houſe, and the ſhadows will be finiſhed.

Of Shadows when the Sun is not ſuppoſed to ſhine, or thoſe produced by common Light.

After what has been ſaid on ſhadows produced by the ſun, it will not be requiſite to ſay much on this head. It will, however, admit of a few remarks.

And firſt, ſuppoſe an object *a*, *b*, *c*, Fig. 47, placed to the light, and conſider the parallel lines as rays of common light falling on it; for common light directs its courſe to ob-

jects

jects in this manner. Now it is evident, therefore, that the side or plane *a* will have most of the light, because the rays fall nearly perpendicular on it, which consequently excludes all shadow; but the plane or side *b* receives the said rays obliquely, and in proportion thereto occasions a shadow, because the light partly misses the surface. The plane *e* is totally in shadow, because the ray *r* cannot touch that surface.

Secondly, in shadows of this kind the contrast of light and shade is not so strong as when the sun's rays fall on objects; the light is not so glaring, nor the shadows so black. The outlines of such shadows ought not to be strongly defined, but faint, and sometimes indistinct, especially when the light is supposed to come from different apertures.

Lastly, such objects as are supposed to be viewed in a room have their upper parts lightest; but the lightest parts will bear a tint, and sometimes considerable, so that there will not be much opposition of light and shade in their different surfaces.

It is requisite to consider the natural colours of objects, in order to fix the tone and true scale of light suitable to them *. The lightest part of an object that is of itself black, would be

* This is also necessary when the sun is supposed to shine.

a shade

a ſhade to one that is white, and therefore, in producing a ſhadow to any thing black or blue, it will require all the force and ſtrength of the Indian ink. The other colours, as green and yellow, &c. will alſo require a due degree of light and ſhade to diſtinguiſh them by.

Mr. Kirby conſiders the colours receding from white to black in the following order: *i.e.* yellow after white, then green, red, blue, and black, ſucceſſively. It is difficult, however, to diſtinguiſh ſome of theſe by the effect of Indian ink, yet it is evident ſomething may be done towards it. Thus: the cube W is ſuppoſed to be white, Y yellow, G green, R red, B blue, and BL black *.

Of the Proportion of Tints ſuited to Objects at different Diſtances in the ſame Picture. See a View, Plate XXVI.

It is evident, from the nature of perſpective in general, that not only the proper dimenſions of objects, but alſo the degree of tint, is eſſential in making them appear at different diſtances.

* This is not the order of the ſimple colours, according to Sir Iſaac Newton's theory of their origin. His theory informs us, that when the rays of light are ſeparated by the refraction of a priſm, the firſt will be red, then orange, yellow, green, blue, indico, and violet, ſucceſſively. See his Optics, Book I. Prop. 6. According to this, white is not a ſimple colour, but a compound or mixture of all that are ſimple, and black a total privation of every colour.

tances. For, as in linear perſpective, objects are viewed under a ſmaller angle in proportion as they are at a diſtance, ſo in the aerial part every tint and ſhadow gradually weakens as the object is ſituated at a diſtance from the front of the picture. The reaſon of this is obvious, when it is admitted that we are made to ſee objects by innumerable beams of light iſſuing from them to the eye. It is eaſy then to conceive, that when theſe beams or rays of light have to make their way through the air from diſtant parts of the horizon to the eye, they muſt greatly weaken before their arrival to it, and therefore ſuch diſtant objects muſt appear leſs diſtinct and more dim in proportion to that diſtance. Hence, in a picture, as in the view given in Plate XXVI. objects on the fore ground are not only larger, but they are more made out, more diſtinct, and ſtrongly marked. Their lights are brighter, and their ſhades are darker, than thoſe on the back ground. This will, perhaps, be more eaſily underſtood by the following obſervations on the view.

The tree on the left is neareſt to the eye of the ſpectator, and is therefore moſt made out; its leaves are ſeen in cluſters, and its ſhade is ſtrong.

The firſt tree on the right, being further back, is leſs diſtinct in its parts, and rather fainter in its ſhadows; and ſo of the reſt in proportion to their diſtance.

With

With refpect to the houfes, we fee the fecond weaker in its parts, and its fhadow, partly on the water and on the ground, fainter than that of the firft. The laft houfe being at a vaft diftance, appears as one mafs without diftinction of parts; and thus objects diminifh off till they and the horizon on which they ftand mix with the fky.

Of the reflected Images of Objects on Water.

To afcertain the reflected images of objects on water is exceeding eafy, and very effential to fome pictures. It is a law in catoptrics *, that the angle of reflection is always equal to the angle of incidence †.

The angle of incidence and reflection may be thus underftood and diftinguifhed. The inclined poft, and its fhadow on the water, form an angle with each other; and at the bottom of the poft, where the line of reflection on the water and the line

* Catoptrics, from κατοπτρον, *katoptron*, a mirror or looking-glafs. Catoptrics teach the fcience of reflex vifion, and optics that of direct vifion, though in the general and extenfive meaning of the term optics, "from οπτομαι, *optomai*, I fee," it includes in it "whatever relates to fight, or the doctrine of vifion;" and therefore muft imply dioptrics alfo, which teaches the properties of refracted vifion; that is, when rays of light pafs through one medium into another, as air and water.

† See fecond axiom of Sir Ifaac Newton's Optics.

of incident rays from the poſt meet, that point is termed the point of incidence; and if from the top of the poſt a perpendicular be let fall, it will form a triangle; and if that triangle be biſected; that is, by drawing a parallel line from the point of incidence *b*, cutting the perpendicular at *c*, then the angle *c*, *a*, *b*, is the angle of incidence; and *c*, *d*, *b*, the angle of reflection, which are equal. Therefore if an object be perpendicular to the horizon, its reflected image on water will alſo be perpendicular, but in an inverted poſition to the object which reflects the image. And whatever angle of obliquity any object makes with the ground, the ſame will be its reflection to the ſurface of the water.

The reflections of images on water are the ſame as thoſe in a plain mirror. The ſurface of the mirror or looking-glaſs is the plane of reflection; and it is evident, that in whatever poſition any object is preſented to it, the ſame will be that of its reflection on the ſaid plane. If a rod, &c. be placed perpendicular to the mirror, its reflected image will be perpendicular to it alſo. And if one end of it touch the glaſs, its image will alſo appear to touch the ſurface of it; or if it is withdrawn, its image will appear equally removed from the reflecting plane. This experiment is within the reach of every one, and will be ſufficient to convince any of the truth of the above propoſition.

EXAMPLE

Example I. See the View, Plate XXVI.

If, therefore, the reflection of the inclined poſt be wanted, let fall a perpendicular at pleaſure, and cut that perpendicular by a line drawn from the bottom of the poſt inclining to the ſaid perpendicular in an angle equal to the object, and it will give the length and inclination of the reflected image. And obſerve, that the length of the reflection on the water will be in proportion to the diſtance of the object from it; conſequently if the poſt were removed a little further from the edge of the water, we ſhould loſe its reflection entirely.

Example II.

If it be required to find the reflection of any of the trees ſuppoſed to ſtand nearly perperdicular, let fall a perpendicular from the bottom of it, and take the whole height of the tree and place it downwards from the bottom of it, then take the length of the trunk and do likewiſe, which will give the reflection as required.

Laftly, it is manifeft from thefe principles, that if any object be floating in the water, fuch as a piece of timber or a fhip, that its reflected image will be equal in length to the object itfelf, and the depth of the reflection below the furface of the water will be equal to the height of the object above it.

END OF THE SECOND PART.

THE

CABINET-MAKER AND UPHOLSTERER'S DRAWING-BOOK.

PART III.

CONTAINING A DESCRIPTION OF THE SEVERAL PIECES OF FURNITURE. 1. OF THE USE AND STYLE OF FINISHING EACH PIECE. 2. GENERAL REMARKS ON THE MANUFACTURING PART OF SUCH PIECES AS MAY REQUIRE IT. 3. AN EXPLANATION OF THE PERSPECTIVE LINES WHERE THEY ARE INTRODUCED. TO WHICH IS ADDED, A CORRECT AND QUICK METHOD OF CONTRACTING AND ENLARGING CORNICES OR OTHER MOULDINGS OF ANY GIVEN PATTERN.

INTRODUCTION.

THE deſign of this Part of the Book is intended to exhibit the preſent taſte of furniture, and at the ſame time to give the workman ſome aſſiſtance in the manufacturing part of it.

I am ſenſible, however, that ſeveral perſons who have already encouraged the work, will not want any help of this

nature; but it is prefumed many will who are not much converfant in the bufinefs, and who have had no opportunity of feeing good pieces of furniture executed.

For the advantage of fuch, it is hoped that the experienced workman will exercife candour and patience in reading the inftructions intended, not for himfelf, but for thofe now mentioned.

There are few but what may, with propriety, reflect on their own paft ignorance, even in things which afterwards become exceeding fimple and eafy by a little practice and experience. Such a reflection ought, therefore, to promote both candour and good nature in the minds of proficients, when they read the documents neceffary to young beginners. And yet, I hope, it may be faid, without arrogance, that it is probable the experienced workman may derive fome information from the fubfequent remarks, when it is confidered that they are made not merely from the knowledge and experience I have myfelf of the bufinefs, but from that of other good workmen.

In converfing with cabinet-makers, I find no one individual equally experienced in every job of work. There are certain pieces made in one fhop which are not manufactured in another, on which account the beft of workmen are fometimes

ftrangers

ſtrangers to particular pieces of furniture. For this reaſon I have made it my buſineſs to apply to the beſt workmen in different ſhops, to obtain their aſſiſtance in the explanation of ſuch pieces as they have been moſt acquainted with. And, in general, my requeſt has been complied with, from the generous motive of making the book as generally uſeful as poſſible.

The methods therefore propoſed, and the remarks made, may be depended on by thoſe who have not yet had an opportunity of ſeeing the different pieces executed.

This is an attempt which has not yet been made in any book of cabinet deſigns, except a very few ſlight hints; and, though it muſt be acknowledged by every impartial mind as highly uſeful, and even in ſome caſes abſolutely neceſſary, yet I am apprehenſive it will not meet with the approbation of thoſe who wiſh to hoard up their own knowledge to themſelves, leſt any ſhould ſhare in the advantage ariſing from it. In ſome inſtances it may be neceſſary for a man to keep knowledge to himſelf, as his own property, and upon which his bread may depend; but I do not ſee any impropriety in perſons of the ſame branch informing each other. In trades where their arts depend on ſecrets, it is right for men to keep them from ſtrangers; but the art of cabinet-making depends ſo much on practice, and requires ſo many tools, that a ſtranger cannot

ſteal it. But in every branch there are found men who love to keep their inferiors of the ſame profeſſion in ignorance, that themſelves may have an opportunity of triumphing over them. From ſuch I expect no praiſe, but the reverſe. Their pride will not ſuffer them to encourage any work which tends to make others as wiſe as themſelves; and therefore it is their fixed reſolution to deſpiſe and pour contempt upon every attempt of this kind, in proportion as it is likely to ſucceed. But thoſe I will leave to themſelves as unworthy of notice, who only live to love themſelves, but not to aſſiſt others.

Here I would beg leave to obſerve, that it is natural for every man under a heavy burden to pour out his complaint to the firſt ſympathizing friend he meets with. If the reader be one of theſe, I will pour out mine, by informing him of the difficult taſk I have had to pleaſe all, and to ſuit the various motives which different perſons have for encouraging a publication like this.

I find ſome have expected ſuch deſigns as never were ſeen, heard of, nor conceived in the imagination of man; whilſt others have wanted them to ſuit a broker's ſhop, to ſave them the trouble of borrowing a baſon-ſtand to ſhew to a cuſtomer. Some have expected it to furniſh a country wareroom, to avoid the expence of making up a good bureau, and double cheſt of drawers,

drawers, with canted corners, &c. and though it is difficult to conceive how these different qualities could be united in a book of ſo ſmall a compaſs, yet, according to ſome reports, the broker himſelf may find his account in it, and the country maſter will not be altogether diſappointed; whilſt others ſay many of the deſigns are rather calculated to ſhew what may be done, than to exhibit what is or has been done in the trade. According to this, the deſigns turn out to be on a more general plan than what I intended them, and anſwer, beyond my expectation, the above various deſcriptions of ſubſcribers. However, to be ſerious, it was my firſt plan, and has been my aim through the whole, to make the book in general as permanently uſeful as I could, and to unite with uſefulneſs the taſte of the times; but I could never expect to pleaſe all in ſo narrow a compaſs: for to do this, it would be neceſſary to compoſe an entire book for each claſs of ſubſcribers, and after all there would be ſomething wanting ſtill.

A DESCRIPTION OF THE SEVERAL PIECES OF FURNITURE.

Of the Univerſal Table. Plate XXV. *of the Cabinet Deſigns.*

THE uſe of this piece is both to anſwer the purpoſe of a breakfaſt and a dining-table. When both the leaves are ſlipped under the bed, it will then ſerve as a breakfaſt-table; when one leaf is out, as in this view, it will accommodate five perſons as a dining-table; and if both are out, it will admit of eight, being near ſeven feet long, and three feet ſix inches in width.

The drawer is divided into ſix boxes at each ſide, as in the plan, and are found uſeful for different ſorts of tea and ſugar, and ſometimes for notes, or the like. In this drawer is a ſlider lined with green cloth to write on. The ſtyle of finiſhing them is plain and ſimple, with ſtraight tapered legs, ſocket caſtors, and an aſtrugal round the frame.

Of the manufacturing Part.

This table ſhould be made of particularly good and well-ſeaſoned mahogany, as a great deal depends upon its not being

liable to caſt. In the beſt kind of theſe tables the tops are framed and pannelled; the bed into two pannels, and the flaps each into one, with a white ſtring round each pannel to hide the joint. The framing is three inches broad, and mitered at the corners; and the pannels are ſometimes glued up in three thickneſſes, the middle piece being laid with the grain acroſs, and the other two lengthways of the pannel, to prevent its warping. The pannels are, however, often put in of ſolid ſtuff, without this kind of gluing.

When the pannels are tongued into the framing, and the miters are fitted to, the tops ſhould ſtand to ſhrink as much as poſſible before they are glued for good. There are different methods of ſecuring the miters of the framing. Some make ſimply a ſtraight miter, which they can ſhoot with a plane; after which they put a couple of wooden pins in. Others, again, having fitted the miters to by a plane, they ſlip in a tenon. But the ſtrongeſt method is to mortice and tenon the miters together, having a ſquare joint at the under, and a miter joint at the upper ſide. This method, however, is the moſt tedious of the three, and where the price will not allow of much time, the above methods are more ready, and, if managed with care, are ſufficiently ſtrong. In gluing the miters, it will be proper, firſt, to glue on the outſide of each miter a piece of deal in the ſhape of a wedge, which will take a hand-ſcrew, ſo that when they

they are putting together, the glue may be brought out, and the miters made cloſe.

The frame, as ſhewn in the plan, is made exactly ſquare, either of faulty mahogany, or of wainſcot veneered. In making this frame a box is formed at each end, about three inches in width, containing two ſliders apiece, which run paſt each other in the ſaid box, as ſhewn in the plan. In the bottom of each box are put two pieces, with plough grooves in them, and raking contrary to each other. In the line N O, on thoſe raking pieces the ſliders run, and are ſtopped from coming too far out by a pin fixed in the under edge of the ſlider; which pin runs in the plough grooves already mentioned, denoted in the plan by a dark line. The raking line of the ſliders is found by taking the width of the flap, as from S to M, and making the line incline in that width equal to the thickneſs of the flap. This may be eaſily underſtood, by placing a rule from the outer point M of the flap, to S the inner point, which then will be parallel to the raking line. The ſliding pieces being in a right line their whole length at the under edge, of courſe their upper edge muſt be bevelled off, ſo that when they are drawn fully out, they may be even, and in an exact line with the top of the frame.

The frame and tops being thus prepared, they are connected together by an iron ſcrew and nut, as at A, which is

about

about the fubftance of a bed-fcrew. This fcrew is jointed into a plate, which plate is let into the under fide of the bed, level with it; though I have defcribed it at A with its thicknefs out, merely that the plate might be fhewn. At B the bed A is reprefented on the frame, and the iron fcrew paffing through the rail of the table, is confined to its place by the nut, which is let into the under edge of the rail by a center-bit. And obferve, in making this center-bit hole for the nut, it muft be funk deeper than its thicknefs, that the bed may have liberty to rife a little, and fo give place to the flaps when they are wanted to be pufhed in. It muft be noticed alfo, from the plan of the frame, that there is a middle piece, about five inches broad, and of equal thicknefs with the flaps, fcrewed down to the frame with four fcrews at each end. This middle piece anfwers three purpofes; it fecures the frame, ftops the flaps when they are pufhed in, and prevents the fliding pieces from tilting.

Before the bed is finally fixed to its place, there muft be four pieces of green cloth let into the under fide of it, to prevent the flaps from rubbing as they flide under. Upon the edges of the flaps a hollow is worked all round, leaving a quarter of an inch fquare, for no other purpofe than to take off the clumfy appearance of the two thickneffes when the flaps are

under

under the bed. At the under ſide of the flaps muſt be goged out finger-holes, to draw them out by.

The drawer is next to be conſidered, which is ſometimes made with two fronts, and to draw out both ways, as in the plan. On each front of the drawer is a lock, for the convenience of ſecuring it at either end; for in caſe one flap be drawn out, then the drawer can be locked or pulled out at the contrary front, without the trouble of puſhing the flap in to come at the drawer.

The covers of each box before mentioned, may have an oval of dark wood, and the alphabet cut out of ivory or white wood let into them, as in the plan; or they may be white ovals and black letters; the uſe of which is to diſtinguiſh the contents of each box.

Laſtly, the ſlider to write on is made exactly half the inſide length of the drawer; ſo that when it is puſhed home to either front, there is immediate acceſs to ſix of the boxes.

And here I would obſerve, that ſometimes the flaps of theſe tables have round corners, but they do not anſwer the bed ſo well when they are in. And, to ſave expence, the tops have been found to anſwer the purpoſe in ſolid wood, without being framed.

framed. When they are made in this manner, particular regard ſhould be had to placing the heart ſide of the wood outward, which naturally draws round of itſelf, and may therefore be expected to keep true, notwithſtanding its unfavourable ſituation.

N. B. The heart ſide of a board is eaſily known by planing the end, and obſerving the circular traces of the grain, which always tend outwards.

The Perſpective Lines explained.

In making deſigns in perſpective, the firſt thing to be attended to is the ſcale of feet and inches, by which to proportion the different parts to each other, to determine the height of the horizon, and the diſtance of the picture.

Having made the ſcale, take from it about five feet ſix for the height of the horizon at H L. On this line place the point of ſight, ſo as to give the moſt favourable view of the deſign, as at *s*. Next lay on the diſtance, which is here out of the plate, and being equal to the ſpace *s a*, agrees to the rule for chooſing a diſtance contained in page 281. Draw *a b* perpendicular to the ground line, and from *a* draw a line to the point of ſight *s*.

Next conſider how much the top projects over the frame, and as much as this is, lay it from *a* towards *e*, as the firſt line ſhews, which is directed to the point of diſtance. Where this cuts the aforeſaid line drawn to *s*, raiſe a perpendicular anſwering to *a b*. From *b* lay on the ſpace *b d*, for the depth of the framing; and from *d* draw a line as before to *s*; and from where the line cuts the ſecond perpendicular, draw a parallel for the under edge of the framing. On a parallel line from *b*, lay on the dimenſions of the bed and flap; and from theſe draw lines to *s*, as the deſign ſhews. Now, as the bed of the table is ſquare, nothing more is wanted to find its apparent width than to draw a line from *o* to the diſtance which cuts at the oppoſite angle; and through this angle draw *r t* parallel, which completes the out-line of the top.

To find the place of the drawer and the boxes in it, proceed thus.—On the ground line make *a e* equal to the whole ſpace, from the drawer in the plan to the projection of the middle piece acroſs the frame. Alſo make *e b* the whole length of the drawer, and *g f* the diviſions for the boxes. From each of which draw lines to the diſtance, cutting at 1, 2, 3, 4; from which draw parallels to 7, 6, 5, 8. Again, from 7 raiſe a perpendicular, and make *k h*, on *k m*, equal to the height of the drawer; from *h* draw a line to *s*; and from *m*, the height of the covers of each box, do the ſame. Laſtly, from 6, 5, &c.

raiſe perpendiculars, which will cut *b s* in the place for the boxes, and at *n* for the height of the covers. How every other thing is done, muſt be obvious from inſpection.

Of the Sideboard Tables, Plate XXVI. *and* XXIX. *and of Tables of this Kind in general.*

THE ſideboard in Plate XXVI. has a braſs rod to it, which is uſed to ſet large diſhes againſt, and to ſupport a couple of candle or lamp branches in the middle, which, when lighted, give a very brillant effect to the ſilver ware. The branches are each of them fixed in one ſocket, which ſlides up and down on the ſame rod to any height, and fixed any where by turning a ſcrew. Theſe rods have ſometimes returns at each end of the ſideboard; and ſometimes they are made ſtraight, the whole length of the ſideboard, and have a narrow ſhelf in the middle, made of full half-inch mahogany, for the purpoſe of ſetting ſmaller diſhes on, and ſometimes ſmall ſilver ware.

The right-hand drawer, as in common, contains the celleret, which is often made to draw out ſeparate from the reſt. It is partitioned and lined with lead, to hold nine or ten wine bottles, as in Plate XXIX.

The

The drawer on the left is generally plain, but ſometimes divided into two; the back diviſion being lined with baize to hold plates, having a cover hinged to encloſe the whole. The front diviſion is lined with lead, ſo that it may hold water to waſh glaſſes; which may be made to take out, or have a plug-hole to let off the dirty water. This left-hand drawer is, however, ſometimes made very ſhort, to give place to a pot-cupboard behind, which opens by a door at the end of the ſide-board. This door is made to hide itſelf in the end rail as much as poſſible, both for look and ſecrecy. For which reaſon a turn-buckle is not uſed, but a thumb-ſpring, which catches at the bottom of the door, and has a communication through the rail, ſo that by a touch of the finger the door flies open, owing to the reſiſtance of a common ſpring fixed to the rabbet which the door falls againſt, as is denoted by the figure A. F is for the finger, B is the braſs plate let into the rail, L is the lever, *p* is the ſpring that preſſes the lever upwards, and *c* is the end of it which catches the under edge of the door as it paſſes over it and ſtrikes into a plate with a hole in it, and *s* is the ſpring ſcrewed to the rabbet which throws the door out when F is puſhed upwards.

But the reader muſt here obſerve, that the ſhape of this ſideboard will not admit of a cupboard of this ſort in the end

rail.

rail. Thoſe which are ſquare at the ends, and only a little ſhaped in front, are fitteſt for this purpoſe.

In large circular ſideboards, the left-hand drawer has ſometimes been fitted up as a plate-warmer, having a rack in the middle to ſtick the plates in, and lined with ſtrong tin all round, and on the underſide of the ſideboard top, to prevent the heat from injuring it. In this caſe the bottom of the drawer is made partly open, under which is fixed a ſmall narrow drawer, to contain a heater, which gives warmth to the plates the ſame as in a pedeſtal.

In ſpacious dining-rooms the ſideboards are often made without drawers of any ſort, having ſimply a rail, a little ornamented, and pedeſtals with vaſes at each end, which produce a grand effect. One pedeſtal is uſed as a plate-warmer, and is lined with tin; the other as a pot-cupboard, and ſometimes it contains a celleret for wine. The vaſes are uſed for water for the uſe of the butler, and ſometimes as knife-caſes. They are ſometimes made of copper japanned, but generally of mahogany.

There are other ſideboards for ſmall dining-rooms, made without either drawers or pedeſtals; but have generally a wine-cooper to ſtand under them, hooped with braſs, partitioned and lined with lead, for wine bottles, the ſame as the above-mentioned celleret drawers.

The

The ſideboard in Plate XXIX. ſhews two patterns, one at each end. That on the left is intended to have four marble ſhelves at each end, incloſed by two backs, and open in front. Theſe ſhelves are uſed in grand ſideboards to place the ſmall ſilver ware on. The pattern on the right is intended to have legs turned the whole length; or rounded as far as the framing and turned below it, with carved leaves and flutes. The diviſion beyond the celleret-drawer is meant for a pot-cupboard.

It is not uſual to make ſideboards hollow in front, but in ſome circumſtances it is evident that advantages will ariſe from it. If a ſideboard be required nine or ten feet long, as in ſome noblemen's houſes, and if the breadth of it be in proportion to the length, it will not be eaſy for a butler to reach acroſs it. I therefore think, in this caſe, a hollow front would obviate the difficulty, and at the ſame time have a very good effect, by taking off part of the appearance of the great length of ſuch a ſideboard. Beſides, if the ſideboard be near the entering door of the dining-room, the hollow front will ſometimes ſecure the butler from the joſtles of the other ſervants.

Of

Of the Perſpective Lines.

HAVING drawn the plan and adjuſted the height of the horizon by the ſcale, as was mentioned in the univerſal table, repreſent a parallelogram *a*, *b*, *c*, *d*, equal to the length and breadth of the table; and from every part of the plan draw lines up to the ground line, and from the ground line direct theſe to the point of ſight. Take from the plan the ſpace M N, and place it from 1 to 2; and from 2 direct a line to the point of diſtance, cutting a point next to *y*; from which point draw a parallel for the place of the front legs. In like manner take the other dimenſions from the plan to find every other correſpondent point in the repreſentation. To find the repreſentation of the hollow and round fronts, conſult the treatiſe on perſpective in pages 294 and 295, together with the lines here ſhewn as hints, and it is preſumed that the learner will not be at any loſs in drawing ſuch a table.

Of the Book-caſe Doors. Plate XXVII. and XXIX.

IN the execution of theſe doors, the candid and ingenious workman may exerciſe his judgment, both by varying ſome parts of the figures, and taking other parts entirely away, when the door is thought to have too much work.

No. 1,

No. 1, in Plate XXVII. might do for a plain door, if the ornament and ſquare part in the middle were taken away.

No. 2 might alſo have the ſquare in the middle taken away, and look very well.

No. 4 may have the upright and horizontal bars away, and No. 5 the ſmall ſquares; and at each angle of the hexagon the ſtraight bar might be carried through to the frame.

With reſpect to No. 6, it may be uſeful to ſay ſomething of the method of making it, as well as of ſome of thoſe in Plate XXIX.

The firſt thing to be done, is to draw, on a board, an oval of the full length and breadth of the door. Then take half the oval on the ſhort diameter and glue on blocks of deal at a little diſtance from each other, to form a caul; then, on the ſhort diameter, glue on a couple of blocks, one to ſtop the ends of the veneer with at the time of gluing, and the other, being bevelled off, ſerves to force the joints of the veneer cloſe, and to keep all faſt till ſufficiently dry. Obſerve, the half oval is formed by the blocks of the ſize of the aſtragal, and not the rabbet; therefore conſider how broad a piece of veneer will make the aſtragals for one door, or for half a door. For a whole door, which takes

takes eight quarter ovals, it will require the veneer to be inch and quarter broad, allowing for the thicknefs of a fash faw to cut them off with. Veneers of this breadth may, by proper management, be glued quite clofe; and if the veneer be ftraight baited, and all of one kind, no joint will appear in the aftragal. Two half ovals thus glued up, will make aftragals for a pair of doors, which, after they are taken out of the cauls and cleaned off a little, may be glued one upon the other, and then glued on a board, to hold them faft for working the aftragals on the edge; which may eafily be done, by forming a neat aftragal in a piece of foft fteel, and fixing it in a notched piece of wood, and then work it as a gage; but before you work it, run on a gage for the thicknefs of the aftragal; and after you have worked the aftragal, cut it off with a fafh faw, by turning the board on which the fweep-pieces are glued on an edge; then having fawn one aftragal off, plane the edge of your ftuff again, and proceed as before.

For gluing up the rabbet part, it muft be obferved, that a piece of dry veneer, equal to the thicknefs of the rabbet, muft be forced tight into the caul; and then proceed as before in gluing two thickneffes of veneer for the rabbet part, which will leave fufficient hiding for the glafs, on fuppofition that the aftragal was glued in five.

The door being framed quite ſquare, without any moulding at the inner edge, proceed to put in the rabbet pieces. Put, firſt, an entire half oval, and ſcrew this to the inner edge of the door, and level with it; then jump up the other half oval to it, and ſcrew it as before; which completes the center oval. Next, fix the ſquare part, having been before mitered round a block, and keyed together; after which, half-lap the other quarter ovals into the entire oval where they croſs each other, and into the ſquare part, liping it into the angle of the door; put in the horizontal bars for the leaves to reſt on; glue on the aſtragals, firſt on the entire oval, tying it with packthread, to keep it on; then the ſtraight one on the edge of the framing, fitting it to the oval; laſtly, miter the aſtragal on the ſquare part, and every other particular will follow of courſe.

With reſpect to the doors in Plate XXIX. all of them may be made nearly on the ſame principles, at leaſt the rabbet parts muſt; but the aſtragals in No. 1, being all of them portions of circles, ſhould be cut out of ſolid wood, and glued on a deal board and ſent to the turner's. The ſame may be ſaid of No. 5, which, in the vaſe part, may have a piece of ſilvered glaſs. The center in No. 2, is intended to have a print or painting in it. The ſweeps, in No. 6, ſhould be cut out of the ſolid, and worked by a tool. As to fixing any part of the ornaments introduced in theſe doors; this is eaſily done, by preparing a

very

very ſtrong gum, which will hold on glaſs almoſt as ſtrong as glue on wood.

Of the Secretary and Book-caſe. Plate XXVIII.

THE uſe of this piece is to hold books in the upper part, and in the lower it contains a writing-drawer and clothes-preſs ſhelves. The deſign is intended to be executed in ſatin-wood, and the ornaments japanned. It may, however, be done in mahogany; and in place of the ornaments in the friezes, flutes may be ſubſtituted. The pediment is ſimply a ſegment of a circle, and it may be cut in the form of a fan, with leaves in the center. The vaſes may be omitted to reduce the work; but if they are introduced, the pedeſtal on which the center vaſe reſts is merely a piece of thin wood, with a necking and baſe moulding mitered round, and planted on the pediment. The pilaſters on the book-caſe doors are planted on the frame, and the door hinged as uſual. The top of the pilaſters are made to imitate the Ionic capital.

Of the Perſpective Lines.

G R is the ground line, and H L the horizontal line, or height of the eye. Lay on the original heights of the book-

 caſe,

caſe, as at *g*, *h*, *i*, *j*, *k*, &c. and draw a perpendicular line at the angle of the piece, as at A; to which direct parallel lines as ſhewn. On the ground line lay *a*, or two feet, for the breadth of the end; and from *b a* direct lines to the diſtance, which is here out of the plate, cutting the viſuals at *d e*; from *e* raiſe a perpendicular, which will determine the front of the book-caſe, provided it be only a foot deep. The perpendicular B is neceſſary, in order to find the perſpective heights of the book-caſe, as ſhewn in the figure.

Of the Library Table. Plate XXX.

THIS piece is intended for a gentleman to write on, or to ſtand or ſit to read at, having deſk-drawers at each end, and is generally employed in ſtudies or library-rooms. It has already been executed for the Duke of York, excepting the deſk-drawers, which are here added as an improvement.

The ſtyle of finiſhing it ought to be in the medium of that which may be termed plain or grand, as neither ſuits their ſituation. Mahogany is the moſt ſuitable wood, and the ornaments ſhould be carved or inlaid, what little there is; japanned ornaments are not ſuitable, as theſe tables frequently meet with a little harſh uſage.

The

The ſtrength, ſolidity, and effect of braſs mouldings are very ſuitable to ſuch a deſign, when expence is no object. For inſtance, the pilaſters might be a little ſunk, or pannelled out, and braſs beads mitered round in a margin, and ſolid flutes of the ſame metal let in. The aſtragal which ſeparates the upper and lower parts might be of braſs; and likewiſe the edge of the top, together with the patera in the upper pannel, as ſhewn on the left hand. The top is lined with leather or green cloth, and the whole reſts and is moved on caſtors hid by the plinth.

Of the manufacturing Part.

The top ſhould be framed in inch and quarter wainſcot, in the figure of a long hexagon, which beſt ſuits the ſhape of the oval. The pannels, which are tongued in, ſhould be of at leaſt three quarters hard mahogany, about nine inches ſquare, and the ſtiles three and an half broad. The top being thus framed of very dry wood, it ſhould be planed over, and ſtand for ſome time at a moderate diſtance from a fire, after which it may be glued together, and when hardened it ought to be planed over again, and remain in that ſtate till the lower part is finiſhed. If theſe methods are not purſued, the pannels will ſhrink, and their joints will draw down the leather or cloth, ſo that the

figure

ſigure of the framed top will appear, eſpecially when it is lined with leather.

Next, it muſt be conſidered how to glue on the mahogany on the framing, ſo as to make the ſurbaſe moulding appear of ſolid wood. Firſt, plough the four ſhort ſides of the hexagon, and then tongue in ſuitable mahogany lengthways, meeting in a ſtraight joint in the center of the top; and, laſtly, after the tonguing is dry, glue in ſtraight joints pieces on the two long ſides of the hexagon, and when dry, the top will be prepared for cutting to its elliptic ſhape.

The manner of framing the upper and lower parts of the carcaſe muſt be learned from the plan.

The upper part, framed in an entire oval, contains the deſk-drawers; and, if thought neceſſary, two ſhort ones may be obtained over the ſide niches.

The cupboard part is framed in two, each of which has a niche at the end, and one-third of the ſide niches; for the niches are all of them divided into three pannels, and the middle pannels of the ſide ones ſerve as doors, by which an open paſſage is gained through the table. There are four cupboards in the whole, divided in the manner ſpecified by the dotted lines in

the

the plan, one or two of which may be fitted up in a neſt of ſmall drawers and letter-holes.

The plinth is framed entire of itſelf, and the baſe-moulding ſtands up a little to receive the whole and hide the joint.

In putting on the baſe-moulding there are two or three methods which I would offer as the beſt I know of. The frame being made ſo thick as to take the projection of the baſe, it muſt then be rabbeted out of the ſolid to receive it. This being done, proceed to glue the baſe in three or four thickneſſes, confining them to their place by hand-ſcrews, or other devices of that nature; but obſerve to let the baſe project further out than the deal plinth, that it may receive the mahogany veneer which is to be glued on lengthways to hide the deal.

After the whole is glued faſt to its place, the veneer on the plinth and the baſe muſt be cleaned off level with each other. The convex parts of the baſe-moulding may be worked with hollows and rounds; and after theſe are finiſhed, the niches ſhould be worked down to them, by a tool made on purpoſe.

Another method of gluing the baſe-moulding is as follows: —Prepare the inch deal, and make cauls to fit the end and ſide niches of the plinth; after which take ſtraight baited three-eighths

eights Spanifh wood, and work the hollow part of the bafe feparate from the torus; then, from quarter ftuff of the fame kind, cut off flips for the torus; heat the caul well, and both wet and heat the flips, which will then eafily bend. When the hollow part is well tempered, and alfo the torus, begin at one end, and by a thin chip run glue in between them; and as you go on drive in nails about every inch, having between the nails and the moulding a thin flip of wainfcot well heated. Obferve to let the moulding pafs beyond the caul at each end, that a pack-ftring may be tied to keep it to its place when it is taken out. The torus may then be worked before it is glued on the plinth.

A third method is, to make the plinth itfelf the caul, and firft work the hollows, and foak them in water a whole night. Next morning take a hand-iron and heat it well, and over the curved fide of which bend the hollow as near as may be to the fweep. Having already a ftop fcrewed on the plinth, jump one end of the moulding to it, and glue as you go on; at the fame time fixing fmall hand-fcrews to draw it to, or brads may be put through the fquare part to affift in this bufinefs, if neceffary, for thefe will be covered by the torus. After the hollow is fufficiently dry, the torus being worked off and well foaked, and bent round the iron as above, it will glue to the hollow without the fmalleft difficulty, by firft jumping it againft the

ftop

ſtop before mentioned; and after it is brought pretty near, take another ſtop and ſcrew it againſt the end of the torus, which will draw it down without further trouble. Theſe two methods are founded on experiment; for, at my requeſt, it was performed by ſome cabinet-makers to my full ſatisfaction; therefore, ſhould either of theſe methods fail in the hands of any, it muſt be owing to ſome defect in the management.

Of the Perſpective Lines.

Draw firſt a plan of the whole, and make G R the ground line, and H L the horizon. From the plan draw perpendicular lines from every part to G R, as ſhewn in the Plate; make *s* the center, and lay on the diſtance, which is here out of the plate. From each perpendicular line drawn to G R draw lines to *s*; then repreſent a parallelogram both at top and bottom, in which the ellipſis may be inſcribed; and draw the diagonal correſponding with that ſhewn in the plan, which will cut the viſual drawn from the ſaid diagonal in the plan, finding a point to guide the ellipſis. For other particulars relative to the repreſentation of an ellipſis, ſee page 294, and Plate XXI; for the repreſentation of the niche, ſee page 295; and for the deſk-drawer, ſee page 231, Prob. 4.

Of the Kidney Library Table. Plate LVIII.

THIS piece is termed a kidney-table, on account of its refemblance to that inteſtine part of animals ſo called. Its uſe, however, is the ſame as that already deſcribed.

The drawers which appear in the deſign are all real, and are ſtrung and croſs-banded, with the grain of the mahogany laid up and down. The pilaſters are pannelled or croſs-banded, and the feet below turned. The view of it below ſhews the ends pannelled, and the back may be ſo too, or it may be plain.

With reſpect to the manufacturing part, I need not ſay any thing after what has been ſaid on the other, except to explain the reading deſk which ſlides out, as ſhewn below. Obſerve, B is the profile of the frame which ſlides out, in the edge of which there is a groove ſhewn by the black ſtroke, and a tongue is put into the edge of the well part to ſuit it. F is the deſk part which riſes by a horſe; and A is a part of that, which riſes at the ſame time to ſtop the book; *b* is a tumbler-hinge let in flush with the top, and hid by the cloth or leather; *c* is a common but-hinge let in the edge of F, and upon the frame B; ſo that when F falls to B, A does alſo. The length of the table is four feet, its width two, and its height thirty-two inches.

Of

Of the Sofa Bed. Plate XXXI.

THE frames of theſe beds are ſometimes painted in ornaments to ſuit the furniture. But when the furniture is of rich ſilk, they are done in white and gold, and the ornaments carved. The tablets may have each a feſtoon of flowers or foliage, and the cornice cut out in leaves and gilt has a good effect. The drapery under the cornice is of the French kind; it is fringed all round, and laps on to each other like unto waves. The valance ſerves as a ground, and is alſo fringed. The roſes which tuck up the curtains are formed by ſilk cord, &c. on the wall, to ſuit the hangings; and obſerve, that the center roſe contains a braſs hook and ſocket, which will unhook, ſo that the curtains will come forward and entirely encloſe the whole bed.

The ſofa part is ſometimes made without any back, in the manner of a couch. It muſt alſo be obſerved, that the beſt kinds of theſe beds have behind what the upholſterers call a fluting, which is done by a ſlight frame of wood faſtened to the wall, on which is ſtrained, in ſtraight puckers, ſome of the ſame ſtuff of which the curtains are made.

The left plate ſhews the plan of the teſter, and the manner of fixing the rods, which are made in two parts to paſs each

other, ſo that the curtains may come cloſe to each other in the center.

The teſter rods ſcrew faſt in front, and hook paſt each other behind. The manner of fixing the teſter up is by an iron bracket at each end; one arm of the bracket ſcrews to the underſide of the teſter, and the other againſt the wall, by driving in plugs for that purpoſe.

Of the Perſpective Lines.

THE left plate ſhews theſe lines, and the right ſhews the ſcales of proportion. Theſe beds ſeldom exceed twelve feet in height, including the feather at top. Their length is ſeven feet, and width about five.

The perſpective lines are drawn by a contracted diſtance, being only one third of the whole. The front of the ſofa is merely a geometrical elevation. For the apparent width of it take five feet from the ſmall ſcale, which is termed one third of the real ſcale of feet and inches; place this meaſurement from 14 to *e*, and draw a line to *d*, cutting at 15; *a*, *b*, *d*, are for the tablets at each end; and at *f* is laid on the full meaſurement of the back tablet, from which lines are drawn to *s* the center,

which

which cuts the back of the ſofa at the line 15, 16, and determines its length. The back tablet being the higheſt, lay on the additional height from 10, and draw a line to *s*, cutting a perpendicular at 11; from which draw a parallel as ſhewn. The line drawn through *b* is to find the front of the dome, which comes forward rather ſhort of half of the breadth of the ſofa. The line 4 is the back of the dome, 5 is the center line, and 3 is its front; 7 ſhews the height of the under ſide of it, 8 of the top of the cornice, and 9 the top of the dome; the reſt muſt be underſtood by obſervation.

Of the Alcove Bed. Plate XL.

THE term alcove, in buildings, means a part of a room ſeparated off from the reſt by columns and arches correſponding, in which is placed a bed: ſo that it is not the particular form of the bed which gives riſe to this name, but the place in which it ſtands. The learned inform us, that the word alcove is from the Arabic *elcauf*, which means a cabinet or ſleeping-place. This deſign is repreſented ſtanding on a plinth, covered with carpet, and having a border round it ſuppoſed to be on the floor of the room. The ſteps are introduced to ſhew that beds of this ſort are raiſed high, and require ſomething to ſtep on before they can be got into. The ſteps are generally covered

with

with carpet, and framed in mahogany. Both this, the ſofa, and French ſtate bed, require ſteps. The dome of this bed is fixed in the ſame manner as the other; but the roſes to which the curtains are tucked up are different. This is made of tin, and covered with the ſtuff of the bed, and unbuckles to take in the curtains behind the roſe. Upon the fluting, as before mentioned, is fixed a drapery in this, as ſhewn in the deſign; and ſometimes in the arch of the alcove a drapery is introduced.

Of the Summer-Bed in two Compartments. Plate XLI.

These beds are intended for a nobleman or gentleman and his lady to ſleep in ſeparately in hot weather. Some beds for this purpoſe have been made entirely in one, except the bed-clothing being confined in two drawers, running on rollers, capable of being drawn out on each ſide by ſervants, in order to make them. But the preference of this deſign for the purpoſe, muſt be obvious to every one in two or three particulars.

Firſt, the paſſage up the middle, which is about twenty-two inches in width, gives room for the circulation of air, and likewiſe affords an eaſy acceſs to the ſervants when they make the beds.

Secondly, the paffage gives opportunity for curtains to enclofe each compartment, if neceffary, on account of any fudden change of weather.

Thirdly, it makes the whole confiderably more ornamental, uniform, and light..

The firft idea of this bed was communicated to me by. Mr. Thompfon, groom of the houfhold furniture to the Duke of York, which, I prefume, is now improved, as it appears in this defign.

The manufacturing part may eafily be underftood from the defign by any workman; I fhall, however, point out a few particulars. The arch which fprings from the Ionic columns fhould be glued up in thicknefs round a caul, and an architrave put on each fide afterwards. The arch fhould be tenoned into the columns, with iron plates fcrewed on, fo that it may be taken off when the bed is required to come down. In this arch a drapery is fixed, with a taffel in the center, and a vafe above. The head-board is framed all in one length, and the two inner fides of the bed tenoned into the head-rail, and fcrewed. The tefter is made in one, in which there are two domes, one over each compartment. It may, however, be made without domes, but not with fo good effect. In the middle of the tefter, perpendi-

cular

cular to the ſides of the paſſage, are fixed two rods, for the curtains above mentioned. Theſe rods are hid by valances, and between the valances is formed a pannel, by ſewing on variegated margins to ſuit the reſt of the upholſtery work. The ornamented margins, and the oval with creſts in the center of the counterpanes, may all be printed to any pattern, at a manufactory which has been lately eſtabliſhed for ſuch purpoſes.

The ſcale ſhews the ſizes which applies to every part of the end of the bed, it being merely a geometrical elevation.

Of the French State-Bed. Plate XLV.

Beds of this kind have been introduced of late with great ſucceſs in England.

The ſtyle of finiſhing them, with the management of the domes, is already deſcribed in general terms, in page 113, &c. I ſhall, therefore, omit it here, and proceed to give ſome hints relative to the manufacturing part. The dome is ſupported with iron rods of about an inch diameter, curved regularly down to each pillar, where they are fixed with a ſtrong ſcrew and nut. Theſe iron rods are covered and entirely hid by a valance, which comes in a regular ſweep, and meets in a point

at

at the vaſes on the pillars, as the deſign ſhews. Behind this valance, which continues all round, the drapery is drawn up by pulleys, and tied up by a ſilken cord and taſſels at the head of the pillars. The head-boards of theſe beds are framed and ſtuffed, and covered to ſuit the hangings, and the frame is white and gold, if the pillars and cornice are. The bed-frame is ſometimes ornamented, and has drapery valances below.

Obſerve, that grooves are made in the pillars to receive the head-boards, and ſcrewed at the top, by which means the whole is kept firm, and is eaſily taken to pieces. Square bolſters are now often introduced, with margins of various colours ſtitched all round. The counterpane has alſo theſe margins; they are alſo fringed at bottom, and have ſometimes a drapery tied up in cords and taſſels on the ſide.

Of the Perſpective Lines.

THIS deſign is in an oblique ſituation, ſo termed becauſe none of its ends or ſides are paralled to the picture. I have here taken the neareſt angle of the bed for the center of the picture, from which raiſe a perpendicular as from ſeven on the ſcale line. Conſider next the height of the horizon, which ſhould be about five feet ſix; taken from the ſcale you draw the

bed by. On the perpendicular line now mentioned lay on the diſtance of the picture from the horizontal line. Then determine the poſition of one ſide of the bed, by drawing a line from the angle E to V; from V draw a line to the diſtance here out of the plate, on the aforeſaid perpendicular; from the diſtance draw a line T U at right angles with this, which produced cuts the horizon, and finds the vaniſhing point for the ends of the bed; conſequently V is the vaniſhing point for the ſides of the bed. From 7 to A is ſeven feet, the length of the ſide; and from 7 to N is the width of the bed. From N A draw lines to D D, the dividing centers, or meaſuring points, found as in Problem VI. Method 2. page 237, which will cut the viſuals for the apparent length and width of the bed. A perpendicular from 5 is the center of the end of the bed; S is the original height of the dome, from which a line is directed to the right hand vaniſhing point, cutting at *d*; a line from *d* finds the center of the dome, and V the top of the pine-apple; *c a* give the height of the cornice; the diagonals 1, 3, 2, 4, find the center of the dome, by raiſing a perpendicular from their interſection. Every other thing will follow of courſe to him who has previouſly ſtudied the rules given; without which, it would be impoſſible to make every particular underſtood here.

Of

Of the Drawing-Room Chairs. Plates XXXII, XXXIV.

These chairs are finifhed in white and gold, or the ornaments may be japanned; but the French finifh them in mahogany, with gilt mouldings. The figures in the tablets above the front rails are on French printed filk or fatin, fewed on to the ftuffing, with borders round them. The feat and back are of the fame kind, as is the ornamented tablet at the top of the left-hand chair. The top rail is pannelled out, and a fmall gold bead mitered round, and the printed filk is pafted on. Chairs of this kind have an effect which far exceeds any conception we can have of them from an uncoloured engraving, or even of a coloured one.

The perfpective lines in the left chair may ferve as hints; but I need not explain them, fince I have fully done this in Plate XXIV. and XXVI.

The parlour chairs in Plate XXXIII. and XXXVI. need no explanation, as every one muft eafily fee how they are to be finifhed.

Of the Sofa. Plate XXXV.

THESE are done in white and gold, or japanned. The loofe cufhions at the back are generally made to fill the whole length, which would have taken four; but I could not make the defign fo ftriking with four, becaufe they would not have been diftinguifhed from the back of the fofa by a common obferver. Thefe cufhions ferve at times for bolfters, being placed againft the arms to loll againft. The feat is ftuffed up in front about three inches high above the rail, denoted by the figure of the fprig running longways; all above that is a fquab, which may be taken off occafionally. If the top rail be thought to have too much work, it can be finifhed in a ftraight rail, as the defign fhews.

Of the Lady's Writing Table. Plate XXXVII.

THE convenience of this table is, that a lady, when writing at it, may both receive the benefit of the fire, and have her face fcreened from its fcorching heat.

The ftyle of finifhing them is neat, and rather elegant. They are frequently made of fatin-wood, crofs-banded, japanned, and the top lined with green leather.

The manufacturing part is a little perplexing to a ſtranger, and therefore I have been particular in ſhewing as much as I well could on the plate.

Obſerve, that in the ſide-boxes the ink-drawer is on the right, and the pen-drawer on the left. Theſe both fly out of themſelves, by the force of a common ſpring, when the knob on which the candle-branch is fixed is preſſed. Figure A is the ſpring which is let in under the candle-branch; C is a lever which is preſſed to B, the end of the drawers, by a ſpring riſing from D; N is a part of the candle-branch, and *e* is the knob juſt mentioned, which is capable of being preſſed down; therefore, if P be ſcrewed into E by preſſing *e*, C riſes and relieves B, which immediately ſtarts out, by a common ſpring fixed on the inſide of the boxes.

Obſerve a patera in the center of the back amidſt the ornament. This patera communicates to a ſpring of preciſely the ſame kind as A; which ſpring keeps down the ſcreen when the weights are up: and by touching the ſaid patera, which has a knob in its center like *e*, the ſpring is relieved, and the weights of courſe ſend up the ſcreen, being ſomewhat aſſiſted by a ſpring at the bottom, which may be ſeen in the deſign. Figure T ſhews the lead weight, how the pulleys are fixed, and the manner of framing the ſcreen before it is covered with ſtuff.

The

The workman will obſerve, that a thin piece of mahogany ſlides out in a groove, to afford acceſs to the weights, and afterwards encloſe them.

There is a drawer under the top, which extends the whole of the ſpace between the legs.

The ſcale ſhews the length of the table, *b* its height, *a* the depth of the drawer, *b c* the depth of the ſide-boxes, and *e d* the height of the ſwell of the ſcreen part; the width of the table is twenty inches.

Of the Tripod Fire-Screens. Plate XXXVIII.

SCREENS of this kind are termed tripod*, becauſe they have three feet or legs.

The middle ſcreen may be finiſhed in white and gold, or japanned; and the other two of mahogany, or japanned. The rods of theſe ſcreens are all ſuppoſed to have a hole through them, and a pulley let in near the top on which the line paſſes,

* Tripod, of τρεις, *treis*, three, and ποδιον, *podion*, a foot. Anciently the word tripod uſed to be applied to a kind of ſacred three-footed ſtool, on which the heathen prieſts were ſeated to receive and deliver their oracles: from which we may learn how time alters words.

and

and a weight being enclofed in the taffel, the fcreen is balanced to any height. The rods are often made fquare, which indeed beft fuits thofe which have pulleys, while thofe that are made round have only rings and fprings.

Such fcreens as have very fine prints, or worked fatin commonly have a glafs before them. In which cafe a frame is made, with a rabbet to receive the glafs, and another to receive the ftraining frame, to prevent it from breaking the glafs; and to enclofe the ftraining frame a bead is mitered round.

Of the Knife-Cafes and Lady's Travelling-Box. Plate XXXIX.

Little need be faid refpecting thefe. It is only wanted to be obferved, that the corner pilafters of the left-hand cafe has fmall flutes of white holly or other coloured wood let in, and the middle pilafters have very narrow crofs-bands all round, with the pannels japanned in fmall flowers. The top is fometimes japanned, and fometimes has only an inlaid patera. The half columns of the right-hand cafe are fometimes fluted out, and fometimes the flutes are let in. The feet may be turned and twifted, which will have a good effect.

As

As theſe caſes are not made in regular cabinet ſhops, it may be of ſervice to mention where they are executed in the beſt taſte, by one who makes it his main buſineſs; *i. e.* John Lane, No. 44, St. Martin's-le-grand, London.

The Lady's travelling-box in the ſame plate, is intended to accommodate her in her travels with conveniences for writing, dreſſing, and working. The front is divided into the appearance of ſix ſmall drawers; the upper three ſham, and the under real. The writing-drawer takes up two of theſe fronts in length, and contains an ink-drawer, and a top hinged to the front, lined with green cloth. The top being hinged at front, by puſhing in the drawer, it will riſe to any pitch. The other drawer on the left, which only takes up one front, holds a kind of windlaſs or roller, for the purpoſe of fixing and winding up lace as it is worked. The middle vacuity, which holds the ſciſſors and other articles of that nature, takes out, which gives acceſs to a convenience below it for holding ſmall things. The boxes on each ſide hold powder, pomatum, ſcent-bottles, rings, &c. The dreſſing-glaſs, which is here repreſented out of the box, fits into the vacuity above the ſciſſor-caſe.

Of

Of the Corner Bason-Stands. Plate XLII.

THE right-hand bason-ſtand contains a cupboard and a real drawer below it; by the top folding down the bason is incloſed and hid when it is not in uſe. The left-hand top is fixed to the ſide of the bason-ſtand by a rule-joint, the ſame as the flap of a Pembroke table; but inſtead of iron the hinges are made of braſs. The right-hand top is hinged to the other by common butt-hinges, by which means it will fold againſt the other, and both may be turned down together. When the tops are in their place, there then appears a rule-joint on both ſides. The front edges of the tops are hollowed and beaded, which hang a little over, ſo that the fingers may get hold to raiſe them up. Short tenons are put to the under edge of the right-hand top, to keep it in its place on the end of the lower part.

The baſon-ſtand on the left has a rim round the top, and a tambour door to incloſe the whole of the upper part, in which is a ſmall ciſtern. The lower part has a ſhelf in the middle, on which ſtands a veſſel to receive the dirty water conveyed by a pipe from the baſon. Theſe ſort are made large, and the baſon being brought cloſe to the front, gives plenty of room. The advantage of this kind of baſon-ſtand is, that they may ſtand in a

genteel room without giving offence to the eye, their appearance being ſomewhat like a cabinet.

Of the Deſigns in Plate XLIII.

THE drawer in the waſh-hand ſtand is lined with lead, into which the baſon is emptied. The upper part, which contains the ciſtern, takes off occaſionally. Below the drawer is a cupboard. Obſerve, that in the deſign the drawer back is ſuppoſed to be behind the baſon; but before the drawer is wholly taken away, the baſon muſt be taken out.

Of the Pot-Cupboard.

THESE are uſed in genteel bed-rooms, and are ſometimes finiſhed in ſatin-wood, and in a ſtyle a little elevated above their uſe. The two drawers below the cupboard are real. The partitions may be croſs-banded, and a ſtring round the corners of the drawer. Theſe feet are turned, but ſometimes they are made ſquare. Sometimes there are folding doors to the cupboard part, and ſometimes a curtain of green ſilk, fixed on a braſs wire at top and bottom; but in this deſign a tambour door is uſed, as preferable. The upper cupboard contains ſhelves, and is intended to keep medicines to be taken in the night, or to hold other little articles which ſervants are not permitted to overlook.

Of the Lady's Secretary.

THESE are ſometimes finiſhed in black roſe-wood and tulip croſs-banding, together with braſs mouldings, which produce a fine effect. The upper ſhelf is intended to be marble, ſupported with braſs pillars, and a braſs ornamented rim round the top. The lower part may be fitted up in drawers on one ſide, and the other with a ſhelf to hold a lady's hat, or the like.

Of the Screen-Table.

THIS table is intended for a lady to write or work at near the fire; the ſcreen part behind ſecuring her face from its injuries. There is a drawer below the ſlider, and the ſlider is lined with green cloth.

The back feet are grooved out for the ſcreen to ſlide in; in each of which grooves is fixed a ſpring to balance the ſcreen by. The top is firſt croſs-banded all round; then a border is put on, ſo broad as to fall exactly where the joint of the ſcreen will be in the top. Beyond that again is put a narrower croſs-banding. When the ſcreen is down the top appears uniform, without any joint, at leaſt not ſo as to be offenſive to the eye. The ſtraining

frame of the ſcreen is made of thin wainſcot, and framed in four pannels. When the ſaid frame is covered in the manner of any other ſcreen, ſlips are got out and grooved and mitered round, and a part of the top which riſes up with the ſcreen is glued on to the ſlip, and as of courſe the top will project over behind, ſo it affords hold for the hand to raiſe the ſcreen by.

Of the two Tables, Plate XLIV.

THE left-hand table is to write and read at. The top is lined with leather or green cloth, and croſs-banded. To ſtop the book there are two braſs plates let in, with key-holes; and in the moulding, which is to ſtop the book, are two pins, with heads and ſhoulders, by which the moulding is effectually ſecured.

The right-hand table is meant to write at only. The top part takes off from the under part, which, having a bead let in at the back and ends of the top, prevents the top part from moving out of its place. This table being made for the convenience of moving from one room to another, there is a handle fixed on to the upper ſhelf, as the drawing ſhews. In the drawer is a ſlider to write on, and on the right-hand of it ink, ſand, and pens. The ſizes are ſhewn by the ſcales.

Of the Lady's Dressing Table. Plate XLVI.

THE ſtyle of finiſhing theſe tables is neat. They are often made of ſatin-wood, and banded; but ſometimes they are made of mahogany. The ſize of this table, which is here three feet, ſhould be increaſed in its length near ſix inches when theſe folding ſide-glaſſes are introduced. The reaſon of this is, that a lady may have more room to ſit between them to dreſs. It ſhould, in this caſe, be made about two inches wider. But, obſerve, the ſize here given is that which is uſed when only the riſing back-glaſs is introduced; and this has been the common way of finiſhing them. Theſe ſide-glaſſes are an addition of my own, which I take to be an improvement; judging that, when they are finiſhed in this manner, they will anſwer the end of a Rudd's table, at a leſs expence.

The glaſs behind riſes up like that of a ſhaving-ſtand. Thoſe on the ſide, fold down paſt each other, being hinged to a ſliding ſtretcher, which is capable of being puſhed backward or forward. If the right-hand glaſs be puſhed to the back it will then fold down, and the other keeping its place will do the ſame. A and B, in the plan, ſhew theſe glaſſes in their place; *e* is the back-glaſs, and *t* is the top, which is hinged to a piece of

of wood, which runs in a groove at each end, ſo that when the top is drawn fully up, it will fall down on the frame. The other folding top on each ſide have each of them a ſmall tenon near the front, as may be ſeen at the edge of the left-hand one. Theſe tenons being let into the middle part, are the means of ſecuring each ſide-top, when they are folded down, and the middle part is put down upon them, ſo that the lock in the middle ſecures the three tops. The drawer on the right is the depth of two fronts, as is eaſily ſeen; the uſe of which is to put caps in. The left-hand fronts are in two real drawers, for the purpoſe of laying ſmall things in. The cupboard in the knee-hole has its front reeded in the hollow part to imitate tambour, and the circular door in the center is veneered and quartered. This cupboard will take a lady's hat as they wear them now. The other dreſſing conveniences are obvious in the plan.

Of the Perſpective Lines.

THESE I only conſider as hints or memorandums to ſuch as have already gone through the regular treatiſe on the ſubject. *a n* is the width of the table; and a line from *a* to *d*, the diſtance, cuts the viſual *n s* in *b*, which gives the apparent width at that diſtance. The front of the table is ſuppoſed to be in the picture, and therefore every meaſurement is purely geometrical; that is, they are taken from the ſcale. From *r* to *o* is the width

of

of the top, except the ſlip behind. Therefore by drawing a perpendicular at *p*, and directing a line from *o* to *s*, the center, it will cut at *p*, and give the height of the top, ſuppoſing it to be raiſed quite up, ready for turning down.

Of the Cylinder Deſk and Book-caſe. Plate XLVII.

THE uſe of this piece is plain, both from the title and deſign. The ſtyle of finiſhing them is ſomewhat elegant, being made of ſatin-wood, croſs-banded, and varniſhed. This deſign ſhews green ſilk fluting behind the glaſs, and drapery put on at top before the fluting is tacked to, which has a good look when properly managed. The ſquare figure of the door is much in faſhion now. The ornament in the diamond part is meant to be carved and gilt, laid on to ſome ſort of ſilk ground. The rim round the top is intended to be braſs; it may, however, be done in wood.

Of the manufacturing Part.

THE manufacturing part of this piece is a little intricate to a ſtranger, for which reaſon it will require as particular a deſcription as I can give to make it tolerably well underſtood.

First,

First, obſerve the ſlider is communicated with the cylinder by an iron trammel, as I, ſo that when the former comes forward, the latter riſes up and ſhews the neſt of the ſmall drawers and letter holes, as appears in the deſign. When, therefore, the ſlider is puſhed home even with the front, the cylinder is brought cloſe to it at the ſame time. In this ſtate the lock of the long drawer under the ſlider ſecures both the drawer itſelf and alſo the ſlider at the ſame time, in the following manner:—D is the long drawer under the ſlider, P the partition above it, and S is the ſlider; C is a ſpring-bolt let into the partition. When, therefore, the drawer lock-bolt is out, as it riſes it drives C, the ſpring-bolt, into the ſlider; and when the drawer is unlocked, then C falls down to its place in the partition, and the ſlider can be pulled out. The trammel I, is a piece of iron near a quarter thick, and inch and quarter broad, with grooves cut through, as ſhewn at I. S, in the profile, is the ſlider; and *g*, 12, *h*, the cylinder. The trammel T is fixed to the cylinder at *h* by a ſcrew, not drove tight up, but ſo as the trammel will paſs round eaſy. Again, at the ſlider S a ſcrew is put through the groove in the trammel, which works on the neck of the ſcrew, and its head keeps the trammel in its place; ſo that it muſt be obſerved, that the grooves or ſlits in the iron trammel are not much above a quarter of an inch in width. When the ſlider is puſhed in about half way, the trammel will be at *u*, and its end will be below the ſlider, as the plate ſhews; but when the ſlider is home

home to its place, the trammel will be at T and *g*. The center piece with four holes is a ſquare plate of iron, having a center-pin which works in the upper ſlit of the trammel. It is let into the end of the cylinder, and fixed with four ſcrews. To find the place of this center, lay the trammel upon the end, as T *b*, in the poſition that it will be in when the ſlider is out, and, with a pencil, mark the inſide of the ſlits in the trammel. Again, place the trammel on the end as it will be when the ſlider is in, as at T *g*, and do as before; and where theſe pencil marks interſect each other will be the place of the center-plate. The figures 1, 2, 3, 4, ſhew the place of the ſmall drawers. The triangular dotted lines with three holes, is a piece of thin wood ſcrewed on to the end, to which is fixed the neſt of ſmall drawers, forming a vacuity for the trammel to work in. F is a three-eighth piece veneered and croſs-banded, and cut behind to give room for the trammel. This piece both keeps the ſlider to its place, and hides the trammel. The next thing to be obſerved is, that the lower frame, containing two heights of drawers, is put together ſeparate from the upper part, which takes the cylinder. The ends of the cylinder part are tenoned with the ſlip tenons into the lower frame and glued. The ſhaded part at A ſhews the rail cut out to let the trammel work. The back is framed in two pannels, and the back legs are rabbetted out to let the back framing come down to the lower drawer. The ſlider is framed of mahogany, with a broad rail at each end about nine inches, and

one at the front about three and an half. In the infide of the framing a rabbet is cut to receive a thin bottom. The bottom being fixed in, a flip is put at each end to receive the horfe which fupports the defk part. The ink and pen drawers at each end of the flider have a fmall moulding mitered round them to keep them faft, without their being glued on. Obferve, there is a fham drawer-front faftened on to the flider, which of courfe goes in with it, and which contains the depth of thefe ink and pen drawers, fo that they are not required to be taken out when the flider goes in. The cylinder is jointed to its fweep in narrow flips of ftraight-baited hard mahogany, and afterwards veneered. If the veneer be of a pliable kind it may be laid with a hammer, by firft fhrinking and tempering the veneer well, which muft not be by water, but thin glue. If the veneer be very crofs and unpliable, as many curls of mahogany are, it is in vain to attempt the hammer. A caul in this cafe is the fureft and beft method, though it be attended with confiderable more trouble than the hammer. To prepare for laying it with a caul, proceed as follows.—Take five or fix pieces of three-inch deal, and fweep them to fit the infide of the cylinder. Fix thefe upon a board anfwerable to the length of the cylinder. Then have as many cauls for the outfide of the cylinder, which may be made out of the fame pieces as thofe for the infide. Take then quarter mahogany for a caul to cover the whole veneer, and heat it well. Put the caul fcrews acrofs the bench, and flip in the

board

board with the round cauls ſcrewed to it; and proceed, in every other particular, as the nature of the thing will neceſſarily dictate.

Of the Perſpective Lines.

G R is the ground line, and H L the horizon; *s* the center, and *d* the diſtance of the picture. A B, on the ground line, is the breadth of the ends; from which a line is drawn to *d*, cutting the viſual B *s*, for the perſpective breadth of the end. O is the height of the lower part, and the upper part being level with the horizon, appears in one line, and therefore ſhews no breadth at the top.

Of the Cabinet. Plate XLVIII.

THE uſe of this piece is to accommodate a lady with conveniences for writing, reading, and holding her trinkets, and other articles of that kind.

The ſtyle of finiſhing them is elegant, being often richly japanned, and veneered with the fineſt ſatin-wood.

The manufacturing part is not very difficult, but will admit of the following remarks.—The middle drawer over the

knee-hole has a flider to write on, and thofe on each fide are plain. The doors under them are hung with pin-hinges, and in the infide there is one fhelf in each. The cupboard within the knee-hole is fitted up in fmall drawers, and fometimes only a fhelf. The pilafters or half columns are put on after the carcafe is made. The corner ones are planed fquare firft, and then rabbetted out to receive the angle of the carcafe, and afterwards deal is glued in a flight manner into the rabbet, that it may be eafily taken out after the column is turned.

The center door of the upper part is fquare at the top, opening under the aftragal which finifhes the cove part. The pilafters are on the door frame, and the drapery is formed and fewed to the filk, and both are tacked into a rabbet together. Behind the filk door are fliding fhelves for fmall books. The wings are fitted up as fhewn in the defign on the right, or with more fmall drawers, having only two or three letter holes at the top.

Of the Perfpective Lines.

GR is the ground line, HL the horizon, and *sd* only half the full diftance of the picture; wherefore *ga* is only half the original meafurement of the ends of the cabinet. A perpendicular from *e* determines the front of the upper part, and all thofe

thoſe viſuals drawn to *s* are obvious in themſelves. The perpendicular lines *c c*, at the cove, ſhew the centers for drawing it. The right-hand door opens more than ſquare, conſequently it is oblique to the picture; and being oblique, the top and bottom of it tend to ſome vaniſhing point out of the center of the picture, as is denoted by the lines *n n*, *s s*. Theſe two, if produced, would meet in a point on the horizon, and that point is termed the vaniſhing point of all lines parallel to the top and bottom of the door. The door turning on its hinges deſcribes a ſemicircle, as is ſhewn; and, conſequently, every opening of the door muſt come within the circumference of that ſemicircle.

Of the Lady's Cabinet Dreſſing-Table. Plate XLIX.

THIS table contains every requiſite for a lady to dreſs at.

The ſtyle of finiſhing them is neat and ſomewhat elegant.

With reſpect to the manufacturing part, and what it contains, theſe may be learned from the deſign itſelf, which here ſhews the parts entirely laid open. I ſhall therefore only mention two or three particulars. When the waſhing-drawer is in, a ſlider which is above it may be drawn out to write on occaſionally. The ink and ſand are in the right-hand drawer under

the center dreſſing-glaſs. Behind the drapery, which is tacked to a rabbet, and fringed or gimped, to cover the nails, is a ſhelf, on which may ſtand any veſſel to receive the dirty water. Above the drapery are tambour cupboards, one at each end, and one in the center under the drawer. Above the tambour at each end are real drawers, which are fitted up to hold every article neceſſary in dreſſing. The drawers in the cabinet part are intended to hold all the ornaments of dreſs, as rings, drops, &c. Behind the center glaſs is drapery; it may be real to ſuit that below, or it may only be painted in imitation of it. The glaſs ſwings to any poſition, on center pins fixed on the ſhelf above the candle-branches. The ſide-glaſſes fold in behind the doors, and the doors themſelves, when ſhut, appear ſolid, with ovals in the pannels, and ornamented to ſuit the other parts. Obſerve, the whole plan of the top is not in the plate, it being required to be two feet over.

The perſpective lines ſhewn at the circular end, are as follows.—When the plan is made, divide the curve into parts, as ſhewn; and from theſe diviſions on the ground line, draw lines to the center *s*. Then turn up the ordinates to the ground line; and from the points where they cut on that line, draw lines to the diſtance, as ſhewn, which will cut the viſuals at 6, 7, 8, 9, and ſo on, finding points to direct the curve by.

Of

Of the Lady's Cabinet and Writing-Table. Plates L.

THIS table is intended for writing on, and to hold a few ſmall books in the back of the upper part. Within the door at each end, under the domes, are formed ſmall cabinets of drawers, &c. The front of the upper part, which incloſes the neſt of drawers and letter holes, ſlides in under the top, and when drawn ſufficiently out falls down in the curve *f g*, and locks into the folding top.

The method of hinging this front is thus:—Suppoſe B D to ſhew it up, as it is in the deſign, ready for puſhing home. Then obſerve, D *d* is a ſlip which runs in a groove cut at each end. The front B is rabbetted out, and alſo the ſlip D. Theſe are hinged together, and are both of one thickneſs, ſo that when B is drawn out, the ſlip having a tenon at *d*, ſtops it from coming entirely out. The other figure ſhews the front when it is let down, which cannot fail of making it underſtood. The dotted curve line *o* P ſhews that the under ſide of the top muſt be hollowed out ſo that the angle of the falling front may clear itſelf as it turns.

Obſerve,

Obſerve, the writing part folds over like a card-table, and when it is open, is ſupported by the drawer in the frame. Every other part muſt be plain to the workman.

N. B. Upon the ſame principles the top of the dreſſing-table, Plate XLVI. is managed.

Of the Drapery. Plate LI.

LITTLE can be ſaid of this, as every part explains itſelf, as repreſented in the drawing. It is, however, neceſſary to obſerve, that the French ſtrapping and taſſels in the right-hand deſign is no part of the cornice, as ſome cabinet-makers have already miſtaken it to be. It is the upholſterer's work, and is ſewed on within the valance or ground of the drapery.

Theſe curtains are drawn on French rods. When the cords are drawn the curtains meet in the center at the ſame time, but are no way raiſed from the floor. When the ſame cord is drawn the reverſe way, each curtain flies open, and comes to their place on each ſide, as they are now repreſented. The cord paſſes on a ſide pulley fixed on the right-hand.

To

To effect this, the rod is made in a particular manner, having two pulleys at one end, and a single one at the other, which cannot well be described in words without a drawing of it.

Of the Gentleman's Secretary. Plate LII.

This piece is intended for a gentleman to write at, to keep his own accounts, and serve as a library. The style of finishing it is neat, and sometimes approaching to elegance, being at times made of satin-wood, with japanned ornaments.

Of the manufacturing Part.

The great thing to be observed in this, is the management of the fall A, or writing part, which is lined with green cloth. This fall is hung by an iron balance-hinge B, so that when the fall is raised up by the hand a little above an angle of forty-five degrees, or in the position it is shewn at A, it falls to of itself by the balancing power of B.

When A is in a horizontal position, B is at F, the inside of the pilaster, on which is glued a piece of cloth to prevent the

iron from rattling. B ſtopping at F it is evident how firmly the fall is ſupported by that means; for the hinge is made very ſtrong, about three quarters thick at the dove-tail end, and tapered off to about a quarter thick at the joint, and where it is ſcrewed to the fall. The hinge is made in two parts, as D and *b*. D has a center pin, and is ſcrewed on to the inſide of the pilaſter, as at *d*; *b* is all in one piece, and is ſcrewed on to the fall, having a center hole to receive the abovementioned pin in the other part of the hinge.

It is neceſſary to obſerve, that there is a vacuity behind both the upper and lower pilaſters in which the iron balance operates, ſo that nothing is ſeen but the mere joint of the hinge.

Again, it is requiſite to obſerve, that a hollow muſt be worked on the upper ſide of the under carcaſs, to give place to the circular motion of the under angle of the fall, as it turns upon its hinge from a perpendicular to a horizontal form. This hollow may be obſerved in the plate. The ſpace 1 contains the fall when it is up; 2 is an open ſpace, which affords room for the rings on the ſmall drawers; and 3 is the pilaſter. The ornamented freeze under the cornice is, in reality, a drawer, which ſprings out when the bolt of the fall-lock is relieved. This is done by a ſpring-bolt let into the partition under the

drawer,

drawer, which is forced up by the bolt of the fall-lock into the under edge of the drawer; and when the fall is unlocked this spring-bolt returns to its place in the partition, and a common spring screwed on to the drawer-back sends it forward, so that it may be drawn out independent of a ring or handle.

When the fall is up, there appear two pannels in the form of those below. As for any other particular, it must be understood by a workman.

Observe, the dimensions of every part may be accurately taken from the profile by the scale.

Of the Cylinder Wash-hand Table. Plate LIII.

These are always made of mahogany, and having a cylinder to rise up to hide the washing apparatus, they look neat in any genteel dressing-room.

They also contain a bidet on the right near the front, and D, a water-drawer on the left near the back, so that when the two are pushed home they pass by each other. The drawer on the front, which appears partly out, runs above the bidet and the water-drawer. The two heights of sham drawers above contain the cylinder, and the two heights of sham drawers be-

low contain the bidet and water-drawer. The bason has a plug-hole at the bottom, by which the water is conveyed off into the drawer D, which is lined with lead. The top of the ciftern is hinged, and can be turned up at any time to fill it with frefh water. The glafs rifes up behind, in the fame manner as that of a fhaving-ftand. And when the glafs is down, the top can be turned down alfo; and the cylinder being raifed to meet it, the whole is enclofed. The motion of the cylinder is guided by two quadrant pieces, one at each end of it, which are hinged to the top in which the bafon hangs. This is fhewn by A in the profile; which, when the cylinder is let fall to its place, will be at B. When the cylinder is raifed up to A, it catches at C, which is a fpring of the fame kind as thofe put on to fecretary drawers. The bidet-drawer is fometimes made to take quite out, having four legs to reft on. The end of the piece of work is cut out fo as the feet can go in without being folded up. This, in the defign, is ftopped from coming quite out, and the framed legs, which appear, fold under the drawer and flip in along with it.

Of the Pembroke Table and French Work Table. Plate LIV.

The ufe of this piece is for a gentleman or lady to breakfaft on.

The

The ſtyle of finiſhing theſe tables is very neat, ſometimes bordering upon elegance, being at times made of ſatin-wood, and having richly japanned borders round their tops, with ornamented drawer-fronts.

The manufacturing part of this table differs but very little from thoſe in common uſe.

The fly brackets which ſupport the flaps are made and fixed in the ſame manner as any other, only I apprehend it beſt to make a dove-tail groove in the front for the drawer ſides, at a diſtance from each end of the drawer-front equal to the thickneſs of the bracket and the inner lining; ſo that the front laps over and covers the whole, as appears in the deſign. In this caſe the lock-bolt ſhoots up into the top of the table. The top and frame may be connected to the pillar and claws, either by a ſquare block glued up, or by a couple of pieces, about four inches broad, half-lapped into each other at right-angles, and double tenoned into the pillar, and ſcrewed to the bottom of the frame, as the profile of the pillar and claw is intended to ſuggeſt.

The workman is deſired to obſerve, that the top of the table, as ſhewn in the deſign, is not meant to repreſent a regular ellipſis, as they are generally made a little fuller out at each

corner

corner of the bed. The reaſon of this is, that the flaps, when turned down, may better hide the joint rail.

Of the French Work Table, Plate LIV.

THE title of this table ſufficiently indicates its uſe. The ſtyle of finiſhing them is neat, being commonly made of ſatin-wood, with a braſs moulding round the edge of the rim.

The front part of the rim is hinged to the top, in the ſame way as the front of a ſecretary or deſk-drawer; ſo that when it is turned up, it faſtens by two thumb-ſprings as they do. The braſs moulding is mitered upon the edge of the rim when the front is up, and after it is hinged; which being cut through with a thin ſaw, the moulding, on the return of the front, will be fair with that on the end.

The ſhelf below is ſhaped ſomething like a boat. The bottom of it is made of inch ſtuff, and double tenonned into the ſtandards, as the profile plainly ſhews. The top of each ſtandard has alſo double tenons, to which croſs-bars are morticed and ſcrewed to the under-ſide of the top.

The ſcale ſhews the proportions of the ſtandard, and the height of the table; its breadth is fourteen or fifteen inches.

The boat part, which ſerves as a convenience for ſewing implements, is ſix inches over the middle, and three at each end.

I have, in theſe two deſigns, introduced ſtrict ſhadowing, that the learner may better judge of its effects in ſuch caſes.— But I muſt obſerve the ſhadows here are rather too faint, becauſe I was afraid to make the plate look heavy. The ſun's rays are here conſidered parallel to the picture, which is fully illuſtrated, by different caſes, in the Treatiſe on Shadowing, ſee page 328. And, therefore, I ſhall only obſerve here to the learner, that, in making out the ſhadows of objects, a harſh outline ought carefully to be avoided. In fact, there ought to be no outline at all, except thoſe firſt drawn by a pencil to determine the boundaries of the ſhadow; after which a large hair pencil ſhould be uſed to fill up the ſhadow. We may likewiſe remark, that if Nature be obſerved duly, ſhe teaches us that the ſhadows of objects are ſtronger neareſt the foot or place where they reſt, and grow fainter the further they recede from the foot of the object. The reaſon of this is: becauſe if ſhadows are very long, as from a houſe, there is a ſtrong reflection of light towards the boundaries, which mixes with the ſhadow, and conſequently weakens it. It is ſomewhat ſimilar to what aſtronomers term a penumbra, or imperfect ſhadow accompanying a total one.

Laſtly,

Laſtly, it may alſo be obſerved, that when an object is totally immerſed in the ſhadow of another, as the table claws are in the ſhadow of the top, there is a ſort of additional ſhadow, occaſioned partly by reflection, and partly by the contact of the two ſurfaces, but theſe are ſhort and imperfect in their boundaries.

Of the Tripod Candle-Stand. Plate LV.

These are uſed in drawing-rooms, for the convenience of affording additional light to ſuch parts of the room where it would neither be ornamental nor eaſy to introduce any other kind.

The ſtyle of finiſhing theſe for noblemen's drawing-rooms is exceeding rich. Sometimes they are finiſhed in white and gold, and ſometimes all gold, to ſuit the other furniture. In inferior drawing-rooms they are japanned anſwerable to the furniture.

Perſons unacquainted with the manufacturing part of theſe ſtands may apprehend them to be ſlight and eaſily broken; but this objection vaniſhes, when it is conſidered that the ſcrolls are made of ſtrong wire, and the ornaments cemented to them.

I could

I could not ſhew to advantage more than three lights, but, in reality, there are four; one at the center, and one at each angle. The top of the left ſtand is a round vaſe, which can be turned and have the ſquare handles put on afterwards. The handles ſhould be placed parallel to two of the feet. The top of the right one is a concave ſpherical triangle, having all its ſides equal.

As to any other part, the workman's own notions will ſuggeſt every thing neceſſary in their manufacture.

Of the Harlequin Pembroke Table. Plate LVI.

THIS piece ſerves not only as a breakfaſt, but alſo as a writing table, very ſuitable for a lady. It is termed a Harlequin Table, for no other reaſon but becauſe, in exhibitions of that ſort, there is generally a great deal of machinery introduced in the ſcenery.

Tables like this have already been made, but not according to the improved plan of the machinery here propoſed.

In this, however, I aſſume very little originality or merit to myſelf, except what is due to the manner of ſhewing and

 deſcribing

defcribing the mechanifm of it: the reft is due to a friend, from whom I received my firft ideas of it.

The particular advantages arifing from the machinery are as follows:

Firft, the neft of drawers, or till, fhewn in the defign, can be raifed to any height, gradually, until at length the whole is out.

Second, when the whole is out, as reprefented in the defign, it cannot be taken away, becaufe of three ftops which keep it in; two at one end, and one at the other, according to the grooves in No. 1.

Thirdly, but if neceffity require that the till fhould be taken quite away from the reft of the table, in order to come at the machinery, then one of thefe ftops at one end is fo conftructed that it can be flipped back, and, the till being raifed up at the fame end where the ftop is flipped back, the two at the other end of courfe will relieve themfelves, fo that the till can be taken quite away.

Fourthly, when the till is replaced, the ftop can be pufhed into the groove agiin by the finger, which returns again into the groove by the force of a fmall fpring.

Fifthly,

Fifthly, The till being let down again until it is perfectly even with the reft of the table-top, it can then be fecured in its place by means of another ftop at the bottom, fo that if the whole table were turned upfide down the till would ftill keep its place.

Sixthly, although the till be raifed and lowered by turning the fly-bracket which fupports the flap, yet the bracket is made to lofe this effect or power by the turn of a key, and the bracket may then be drawn out to fupport the flap without raifing the till, and the table can then be ufed, as in common, to breakfaft upon.

Thefe are all the advantages that are neceffary, or that can be looked for, in tables of this fort, to render them complete, and to obtain the approbation of the ingenious.

But it will now be requifite to fhew in what manner the machinery operates fo as to effect thefe; and, likewife, to give fome defcription of its parts, that the workman may be able to form a proper idea of the whole.

The firft and great thing to be attended to is, to fhew the manner of raifing the till by turning the fly-bracket. To ac-

compliſh this, I have given a perſpective view of the whole machinery at No. 1. Suppoſing the till to be taken out, and the fly-brackets and inner lining away from the framing; *a b* is an upright iron axis, made in two parts, and connected together by a round pin at the joint *b*; of courſe, if the winch *c* be turned round, the axis *a* will turn round with it by the above pin, without moving the lower part of the axis *b*. Whence it is evident, that if the winch *c* be ſcrewed to the under edge of the fly-bracket, which bracket is ſhewn in the deſign, it will turn round without affecting any part of the machinery. This is the cauſe why the flap of the top can be up whilſt the till is down. But if the ſquare ſocket *a* be preſſed down paſt the joint *b*, the two parts of the axis will then be confined together, and therefore if the winch *c* be moved this way, it is evident that the machinery will inſtantly be put in motion in the following manner:

The winch *c* being ſcrewed to the fly-bracket, and turned ſquare out, it deſcribes by its paſſage a quadrant of a circle; and the arm *s* of the crank-rod being fixed faſt into the ſame axis *a b*, conſequently it will deſcribe the ſame curve as the bracket: and as the crank-rod R is jointed into its arm at *s* and at *t*, in moving the arm the rod R is puſhed forward to *j*, and the horizontal cog-wheel H of courſe turns to the left-hand on the center C. It being then turned to the left, as expreſſed by the dotted

dotted line at *q*, it follows that the upright cog wheel N muſt be turned to the right-hand; and if this be turned to the right-hand, then muſt alſo the quadrant cog-wheel Q on the left turn to the right with it: and, becauſe the axis A is fixed faſt in the wheel Q, and the crooked levers *e e* into A, conſequently the rollers L L, fixed by the rod *o* to theſe levers, will deſcribe a quadrant of a circle, as denoted by the dotted line and the roller 9; becauſe the connecting cog-rod 5 makes Q move in the ſame curve as N does. Again, if N, the upper part of the upright cog-wheel, move to the right, then muſt M, the lower part of it, move to the left; and, being connected with the cog-rod 6, and it again to the right-hand quadrant cog-wheel Q, it follows, as before, that the levers *f f*, and the roller L, will deſcribe a quadrant of a circle to the left-hand, as at 8. The reader muſt eaſily ſee now, that when the winch *c* is turned by the fly-bracket, that every part of the machinery will be put in motion, and that the levers and rollers, in approaching gradually to 8 and 9, muſt neceſſarily raiſe up the till. But it muſt alſo be obſerved, that the motion of the levers *f f* and *e e* is greatly promoted by the power of the common ſteel-ſprings S S; for, when the till is down, theſe are always charged; that is, the ſides of the ſprings are nearly cloſe to each other, and theſe being connected with what may be termed the auxiliary, or aſſiſtant cog-rods, 4 and 7, and conſequently preſſing againſt their ends, the quadrant cog-wheels Q Q are thereby made to revolve, and the levers and rollers are raiſed almoſt

as

as much by this means as by the other machinery. It muſt alſo be noticed, that as theſe ſprings and auxiliary rods greatly aſſiſt the other power in raiſing the till, ſo do they alſo check the ſudden fall of it, by a conſtant reſiſtance againſt the preſſure of it, ſo that the paſſage of the till downwards is made by this mean ſmooth and eaſy.

Obſerve, *p*, *p*, *p*, *p*, are braſs pulleys fixed to keep the cog-rods in their place, and *w w* are pieces of wood to keep the ſprings firm to their center.

The reaſon why there are but three rollers, and two of them at one end, is obvious; becauſe the till muſt reſt truer on three points than on four. It cannot totter on this account when it is fully raiſed, becauſe there are two ſtops at that end where there is only one roller, which run in the grooves G G; and if the ſtops chuck up to the end of the grooves when the till is up, it is impoſſible that it can totter, conſidering that the other end is upon two rollers. And here let it be noted, that if the workman find any inconvenience owing to the double roller *o* being at the ſame end with the axis *b b*, it can be removed by putting the double roller where the ſingle one is, which makes no difference with any other part of the machinery. And obſerve, that when the rollers are nearly perpendicular to their axis A A, they enter upon an inclined plane, or on thin pieces of wood

planed

planed off like a wedge, of the width of the rollers, and whofe thin end is glued to meet the rollers as they rife, fo that the till can thereby be raifed as high as we pleafe. Thefe wedges being glued on the under fide of the till to fuit exactly the place of the rollers, the projection of the wedges below the till makes it neceffary that there fhould be a vacuity in the axis A A, for them to fall into when the till is down; becaufe, in this fituation, the till refts on the three rollers, which are nearly on a level with the axis A A. And as the wedges above mentioned muft lie acrofs the axis A A when the till is down, every workman muft fee the neceffity of a vacuity, or otherwife the till would not fettle to its place.

The next thing in order is to fhew how one of the ftops can be relieved, or flipped back, fo that the till may be taken quite away. The conftruction of this ftop is fhewn by No. 4, which fuppofes that we fee the under-fide of the till. A is a hole cut through the till, which hole is drawn by a compafs, having one foot at C the center. P is a round pin, which comes through to the infide of the bottom of the till. K is a tin key which hooks this pin. In applying this key to the pin, the writing flider, fhewn in the defign, muft be pufhed in, and the front-part which covers the letter holes turned up to its place; and there being a groove acrofs the under fide of the flider, exactly

where the pin comes, and the ſlider giving a little way for the thickneſs of the aforeſaid key, the groove juſt mentioned admits the key over the head of the pin P; then, when the key is drawn back again, P moves toward A by the center C; and S, the ſtop which projects beyond the till, is by this mean drawn within. B is a plate ſcrewed on to the till to keep the ſtop firm. Again, when the till is down to its place, it is neceſſary that it ſhould be ſtopped there alſo, as has been already ſaid. The apparatus for this is ſhewn at No. 3, which is a different view of the ſame lock as at No. 2. 1, 2, 3, 4, is ſuppoſed to be a part of the bottom, not of the till, but that whereon the machinery is placed at No. 1. *t s* is a kind of trammel with ſlits in it, moving on a center at *s*. A pin is fixed to the bolt of the lock, and there being a paſſage for the pin cut out of the lock-plate, as ſhewn in the deſign, this pin moves up and down, according as the key is turned. *a* is a kind of lever, with two arms, moving at the center *a*. *c c* are ſtaples which are faſtened to the underſide of the till, and as the bolt of the lock ſhoots downwards, the trammel *t s* throws the arms of the lever out of the ſtaples which are fixed to the underſide of the till; by which means the till is relieved, and can then be raiſed by drawing out the fly-bracket. And here the workman muſt be careful to obſerve, that when the bolt *b*, No. 1, is ſhot, as it now appears, the till is always relieved, and the bracket at the ſame time has power

power to raiſe the till; becauſe the fork D works in the groove *d* of the axis *a b* at No. 1, and thereby preſſes the ſocket *a* to *b*, and gives the winch *c* power over the machinery. And obſerve further, that when the bolt *b* at No. 2 is up, as it is ſhewn at No. 3, then it is evident that the arms of the ſtop-lever will paſs through the beforementioned ſtaples at the underſide of the till and ſecure it, while, at the ſame time, the bracket will loſe its power over the machinery; becauſe the ſocket *a*, at No. 1, is thereby raiſed above *b*, and of courſe as *b* turns on a pin, the winch *c* cannot affect the crank-rod *s* R, and therefore no part of the machinery is moved. Thus it is, I think, ſufficiently clear that the till can be ſtopped and relieved when it is either up or down, and alſo that the bracket can be drawn out to ſupport the flap, while, at the ſame time, the till is both down and ſtopped, ſo that the whole may be uſed as a common breakfaſt table.

It remains now to give ſome hints reſpecting the manufacturing part.

Of the Table Top.

THE ſize of the table when opened is four feet, and two feet ſeven inches long; and the rails eight and a quarter deep.

 The

The whole top is divided into four compartments, to anſwer the opening for the till. Round theſe compartments is a japanned border, to fill up the ſpace which lies between the end of the table and the end of the till. This border muſt be continued all round alike, to make the pannels appear uniform and of equal ſize. The bed of the top ſhould be framed in two pannels of three-quarters mahogany well ſeaſoned, and the breadth of the ſtiles to ſuit the opening of the till. A pannel of half-inch ſtuff ſhould be tongued into the other part of the bed where the till does not riſe. Then, for the ſake of the aſtragal which is to be worked on the edge of the top all round, a piece ſhould be tongued in, the long way of the grain, into each end of the bed. And obſerve, that as the bed of the table will frequently have to be taken off in the courſe of the work, it is beſt to put ſmall tenons into the under ſide of it, and mortices into the rails all round; by which means the bed will be kept to a certain place, and taken eaſy off at any time. A black ſtring is put next the till, all round the inſide of the border, to hide the joint. In putting this black ſtring on at the opening of the till, the inſide of the mahogany frame ſhould be rabbetted out to take a ſlip of black veneer about three-eighths wide; and it being left to ſtand above the framing the thickneſs of the veneer, this black ſlip can be ſhot by a rabbet-plain to the thickneſs of a neat ſtring, and the veneer muſt be jumped to it. The uſe of this is, that when the till riſes it may not take any part of the ſtring away

with it, which it certainly would do if it were put on merely as a corner ſtring.

Of the Till.

THE carcaſs of the till is made of half-inch mahogany; the partitions and letter-holes of thin quarter ſtuff, and black beads put on their edges, all of which muſt be kept back about half an inch from the edge of the carcaſs, to give place to the writing-ſlider; part of which turns up as a front to the inſide of the till, and part of it remains in it: and, as a part of the writing-ſlider remains in the bottom of the till below the drawers, conſequently there muſt be a joint in the ſlider to anſwer it; which joint is hinged at each end, before the croſs-band is put on for the green cloth. The workman may make the hinges himſelf to ſuit that purpoſe. They may be made as common deſk-fall hinges, only the knuckles of the hinge are made a little higher than common to receive a thin veneer; which, when ſcrewed on, the veneer for the band of the cloth lies upon and covers the ſtraps, ſo that a part of the knuckle is only ſeen: but obſerve, that the ends of the veneer, each meeting at the knuckle, muſt be cut in a ſloping direction, ſo that they and the braſs knuckle between them will be exactly in the form, and of the ſame nature, as the rule-joint of a fly-bracket for a Pembroke

 table;

table; and therefore it muſt be evident to every workman that the front will turn up ſquare. The ſlider is ſtopped into the till by a couple of pins which run in grooves; and when it is puſhed home, before it can turn up, a hollow muſt be worked in the bottom of the till, to give room for the angle of the riſing part of the ſlider to turn in. When the ſlider is turned up, it is kept in its place by a ſpring-catch, which ſtrikes into a plate put on at the under ſide of the top of the till. And obſerve, that when the front is up, it ſhould be rather within the carcaſs of the till, both for the purpoſe of letting the till go eaſy down, and to admit of a ſlip of thin green cloth at each end, ſo that when the front is turned upon the top of the Pembroke table it may not ſcratch it.

Another method may, however, be propoſed, and which will be attended with leſs trouble; only with this diſadvantage, that it takes off a little of the height of the drawers.

The ſlider, being made in two parts, may be hinged in the manner of a card-table top, which, when it is folded over, can be puſhed to its place. But obſerve, that the under top muſt be made ſo much broader than the upper one, as will admit of its being ſtopped in after the manner of the other; ſo that when it is drawn out, the upper top will riſe and clear the drawer fronts. If the ſlider be made in this manner, the drawers can

then

then be brought within a little of the front edge, and what remains serves to give place to a couple of thumb-nail holes to draw out the ſlider by.

N. B. The proſpect door is made to run in at the top like a drawer, upon the ſame principles as the front of the cabinet in Plate L.

Of the Frame of the Table.

THE legs are made a little ſtronger than uſual, becauſe the table is pretty heavy altogether.

Both the end rails are divided into four drawers each, in appearance; but, in reality, there are but two in the whole: for obſerve, that, for the ſake of ſtrength in the frame, the lower drawer of the left hand is made real, and that above it is a ſham; but at the other end, which is not ſeen in the deſign, the upper drawer is real, and the under one a ſham. A middle rail is tenonned, of inch ſtuff, into each end rail. Againſt this rail the upright part of the machinery is fixed, as ſhewn at No. 1; and as this rail ſtands within the edge of the top-framing about an inch, it contains the whole projection of every part of the machinery, ſo that the till paſſes without obſtruction.

The

The inner lining for the fly-brackets to fall againſt, is not leſs than three quarters thick when planed; and it muſt be the whole breadth of the end rails, i. e. eight and a quarter. The fly-bracket makes up the remaining thickneſs of the foot, and comes down low enough to anſwer the height of the upper croſs-band of the lower drawer. The part remaining below the bracket is veneered the whole length with ſatin-wood, and croſs-banded, to match the drawer fronts. The workman, in making the fly-bracket to which the winch *c* is ſcrewed, muſt obſerve to make a ſhoulder pin on the turning part of it at the under edge: and this ſhoulder will require to be double the uſual thickneſs, that the iron winch *c* may be let into the bracket without injuring the rule-joint, or interfering with the wire of its center.

The lock, at No. 2 or 3, is put on at the inſide of the inner lining, ſo near to the axis *a b*, at No. 1, as that the fork D of the lock ſhall extend to the groove *d* in the ſocket of the axis *a b*, which then will determine the place of the key-hole, as ſhewn in the deſign.

Of the Pediments. Plate LVII.

WITH refpect to thefe pediments little can be faid, as the defigns themfelves fhew in what manner they fhould be executed.

No. 1. Should have the facia, or ground board, glued up in three thickneffes, having the middle piece with the grain right up and down. The foliage ornaments are cut out along with the aftragal, and planted on; and the whole may eafily be made to take off from the cornice, by having a tenon at each end and one in the center.

No. 2. The tablet part is intended to have a crofs-band round it, and the drapery may be japanned. The aftragal on the top of it is meant to return over the ogee. The fquare of the ogee may come forward, level with the tablet, to prevent too great a projection.

No. 3. In the center there are two pilafters to project a little from the ground, which are fluted. The pannels at each end are intended to be fanned the reverfe way, or with the rounds out.

No. 4.

No. 4. The ſcrolls are continued in one piece from the foliage, and planted on.

No. 5. The center is intended to be veneered and croſs-banded, with an oval let in, and japanned. The pedeſtal above is intended to be thrown back in a hollow carved in leaves. The foliage on the ſcrolls is meant to lap on the aſtragal, and to finiſh off at the patera. The ground of the facia is fanned out.

Of the Cornices. Plate LIX.

IN theſe cornices the ſpring is ſhewn, and the proper gaging is pointed out. The width and thickneſs alſo of the mahogany is ſhewn. The aſtragal, in No. 3 and 5, can be worked ſeparate, and glued on afterwards. The pateras, in No. 6, are turned and planted on.

Of the Method of gaging and working Cornices.

THE explanation of this may be thought, by ſome, an unneceſſary buſineſs; but from the bungling manner in which I have ſeen many workmen proceed to ſtick cornices, I am certain

tain that a few hints will be of ſervice, eſpecially to the inexperienced. For this purpoſe I have, in No. 1, lettered each gage-point, and I ſhall proceed as ſuppoſing that it is neceſſary that the whole ſhould be taught.

When the pattern of any cornice is given to be worked, take the drawing and ſtrike a line *a n* to touch as near as may be each member. From this front line ſtrike one at each end ſquare from it, ſo as to take in the whole extent of the cornice. Then draw another line parallel to that on the front, to ſhew the neceſſary thickneſs of the mahogany, and proceed as follows:

Let the ſtuff be ſawn out broad enough to plane to *b o*; after which, plane it true on both ſides, and glue on deal of the breadth of *e p*, and thick enough to make out the whole ſpring of the cornice. After the glue is dry, plane the mahogany to the exact breadth of *b o*. After ſtriking a ſquare line acroſs the mahogany, extend the compaſſes from *a* to *a*, and to *c*, *f*, *g*, &c. and lay all theſe points on the ſquare line, and run a gage thro' each of them. Run then a gage from *a* to *b*, and from *n* to *o*; and taking a bevel, fix the handle of it exactly by the front line, and let the inſide of the blade of it correſpond with *o p*. With the bevel thus fixed, plane down the wood behind till it fit the bevel in every place, and be brought down to *o*. Take

 then

then a ſquare, and plane down the wood at *b* and *e* till the ſquare fit in every place, and the wood is brought down to *b*. After this lay the cornice on the ſide *o p*, and ſhoot off the wood *a*, *a*, *b*; then lay it on the ſide *b e*, and ſhoot off the wood at *n o* to *m*. The cornice being thus properly ſprung, faſten it down on the ſide *a p*, and proceed to rabbet out the ſeveral ſquares. Begin at *c* and rabbet down to *f*; at *b* run on a ſide gage, and, entering in by a ſnipe's-bill, work down to *i*, the fluting being laid on afterwards; at *q* run on a ſide gage each way for the ſquare of the ovalo. From *i* rabbet down to *k*, and at *l* down to *m*; and thus it is evident that the whole cornice, of whatever kind, cannot fail of being correctly worked.

Of the Method of contracting and enlarging Cornices.

SUPPOSE A to be a cornice already drawn or worked, and it be required to draw and work one a third, fourth, or any other proportion narrower than A, and, at the ſame time, to contract its projection in proportion to its height:

Take the compaſſes and extend them to *a o*, the whole height of the cornice A, and with this opening ſweep an arch each way, and where they interſect, to that point draw right-lines from *o* and *a*, forming an equilateral triangle. In the ſame manner

manner proceed with the projection of A, as ſhewn in the figure. To the ſummits of thoſe triangles draw lines from the ſeveral heights and projections of each member. If the cornice to be drawn is to be one third leſs, then divide any one ſide of the triangles into three equal parts, and take one part from *o* to *p*, and let fall a perpendicular from *p*; and from where this perpendicular cuts each line draw parallels, which will give the height of each member in exact proportion. For the projections: *o q* is one third of the ſide of the triangle, as before; draw a parallel line at *q*, which will give the ſeveral projections ſought. Take *q t*, and transfer this to *p r*, and ſo of the reſt, till you have laid on each projection; after which let fall perpendiculars, as ſhewn at No. 7, and proceed to draw the outlines of each member within their proper ſquares, and the cornice will be contracted in the moſt accurate manner.

Of enlarging Cornices.

Suppose now the cornice A is required to be higher than what it is at preſent. Draw parallel lines from each member, and having fixed the compaſſes to the height propoſed, fix one foot at *o*, and move the other till it touch any where on the line *a k*, as at *k*; draw a line from *c* to *k*, and where this line interſects with each parallel before drawn, will be the ſeveral heights

 of

of the mouldings as required. To find the projection, proceed thus:—ſweep the arch *a c*, cutting *o k* at *b*; take *a b* and place it from *c* to *d*, and from *d* draw a line to *o*, and *o m* will then be the whole projection of the cornice proportionable to the height *o k*; conſequently where the line *o m* interſects, each perpendicular raiſed from the ſeveral projections of A, will be the ſeveral projections ſought. *o m* is then a ſcale line for the projections, and *o k* for the heights of each member; and having theſe, the cornice can then be drawn on a ſeparate paper, in the ſame manner as A was drawn at firſt.

By continuing the parallel lines of A to the right, as ſhewn in the plate, and by letting fall its perpendiculars to any length, it is evident that A may be enlarged as much as we pleaſe, by drawing the line *o k* more oblique, as at *e*, which then makes it rather more than one third higher. Then, by extending the compaſſes from *a* to where *o e* cuts the arch, and by replacing this opening from *c* to *g*, and ſtriking a line from *o* to *g* through to *f*, *o f* will be its projection as before; on which principles *o f* will be in a ratio with *o e*. This the workman can prove, for by comparing *o f* with the length of the projection of A, he will find it rather more than one third longer; and by compairing *o e* with *o a*, he will find it rather more than one third longer alſo.

Thus it is evident that any cornice or moulding whatever, and however complex, may be contracted and enlarged as we pleaſe, and that with the greateſt mathematical nicety.

Of the Lady's Drawing and Writing Table. Plate LX.

THESE tables are finiſhed neat, either in mahogany or ſatin-wood, with a braſs rim round the top part. The upper part is made ſeparate from the under part, and fixes on to it by pins.

The riſing deſk in the middle may be made to ſlide forward *, which will then ſerve to draw upon; and the ſmall drawers below the coves at each end, will be found convenient for colours.

The drawer in the middle of the front ſerves to put the drawings in.

The top is lined with green leather or cloth.

The ſcale ſhews the ſize of every part in the front, and the breadth is two feet three inches.

The height of the upper part is eight inches.

* See the directions given for the Kidney Table.

Of

Of the Dining Parlour. Plate LX.

This method of reprefenting a dining or drawing-room has its advantages; though the moft general method is by a plan and fection, as the drawing-room in Plate LXI. In this method the end wall neareft the eye is fuppofed to be laid level with the floor, without which the infide of the room could not be feen. The advantage of this is, that the walls, furniture, and every particular, are fhewn in their natural pofition, except the firft end, fo that the effect of the whole may be better judged of than in the other method.

The advantage of the method in Plate LXI. is, that the fides and ends of the room being turned down, from a geometrical plan, every thing on the walls is fhewn geometrically, and therefore the parts are more diftinct; but with this difadvantage, that it muft be viewed at four different times, by turning each end and fide to the eye; whereas, in the other way, the whole is feen at one view.

In proceeding to draw after the method of Plate LX, make a fcale of feet as there fhewn, and draw G R for a ground line, and H L for the horizon. Let the center of the picture be in the

the middle of the end; and, as these are views of a short distance, extend the compasses from the center to *o*, and turn it up to *d*, which will be the shortest distance that can be applied. Draw visuals from *o*, *c*, *b*, *a*, to the center. From *o* to 1 lay on the size of the first pier, and draw a line to *d*, which, cutting the visual drawn from *o* to the center, gives the perspective of it. Then lay from 1 to 2, the breadth of the window, and draw a line to *d*; and in like manner find the appearance of all the piers and windows. Observe, that a line from R to *d* finds the whole length of the room. How every other part must be drawn will be obvious to every one who understands perspective, and no other with any propriety can attempt it.

This dining-parlour gives a general idea of the Prince of Wales's in Carlton House; but in some particulars it will be a little varied, as I had but a very transient view of it.

The Prince's has five windows facing St. James's Park. This also has five, one of which is hid by the left column. His windows are made to come down to the floor, which open in two parts as a double door, leading to a large grass plat to walk in. If I remember right, there are pilasters between each window; but this is intended to have glass. In his is a large glass over the chimney-piece, as this has. To these glass frames are fixed candle-branches. At each end of his is a large sideboard, nearly

twelve

twelve feet in length, ſtanding between a couple of Ionic columns, worked in compoſition to imitate fine variegated marble, which have a moſt beautiful and magnificent effect. In the middle are placed a large range of dining-tables, ſtanding on pillars with four claws each, which is now the faſhionable way of making theſe tables. The chairs are of mahogany, made in the ſtyle of the French, with broad top-rails hanging over each back foot; the legs are turned, and the ſeats covered with red leather.

I could not ſhew the curtains of each window without confuſion, but they are of the French kind.

Many dining-rooms of the firſt nobility have, however, only two columns and one ſideboard; and thoſe of leſs note have no columns.

The general ſtyle of furniſhing a dining-parlour ſhould be in ſubſtantial and uſeful things, avoiding trifling ornaments and unneceſſary decorations. The pillars are emblematic of the uſe we make of theſe rooms, in which we eat the principal meal for nature's ſupport. The furniture, without exception, is of mahogany, as being the moſt ſuitable for ſuch apartments.

Of

Of the Drawing Room. Plate LXI.

In drawing a room of this kind very little perfpective is wanted. All that is required is a horizontal line on each wall. And I would not advife drawing every object on each wall to one point of fight, as thofe at the extremities will thereby become exceedingly diftorted and unnatural. For, upon fuppofition that the fpectator moves along to different ftations as he views any one fide of the room, perfpective will admit that the defigner have as many points to draw to as the fpectator had ftations to view from. If a room of this fort be narrow, fewer points may do for the furniture at each end, with a little management; but the furniture on the fide walls fhould have almoft as many points as pieces of furniture. The line that marks out the boundaries of the floor, ferves as the proper ground line to each horizon, and the geometrical meafurement of each piece being taken from the fcale and laid down on the wall, the perfpective is drawn from each point backwards, or into the room.

A drawing-room is of that fort which admits of the higheft tafte and elegance; in furnifhing of which, workmen in every nation exert the utmoft efforts of their genius.

To affift me in what I have here fhewn, I had the opportunity of feeing the Prince of Wales's, the Duke of York's, and other noblemen's drawing-rooms. I have not, however, followed any one in particular, but have furnifhed my ideas from the whole, with fuch particulars as I thought beft fuited to give a difplay of the prefent tafte in fitting up fuch rooms.

It may not be amifs to mention fome particulars refpecting the Prince's room, that the reader may form fome idea of its tafte and magnificence.

Its proportions are as follows:—forty-eight feet fix inches long, thirty-four broad, and between eighteen and nineteen feet high, including the cove of the ceiling.

It has five windows in length, a fire-place at each end, and five doors. Two doors are at each end, one of which is fham; and a large arched double door nearly in the center oppofite the windows.

Oppofite each window is a large glafs, with a circular top, to fuit the arches above the windows; and over each fire-place there is alfo a glafs. In the piers between each window there are no glaffes, but a couple of richly finifhed Corinthian pilafters, with their architrave and impofts to fuit the tops of each

window. On the ſide oppoſite to the windows the ſame pilaſters are employed; for, as the before-mentioned glaſſes each occupy a ſpace equal to the width of a window, and are directly oppoſite to them, this preſerves a regularity in the pilaſters on both ſides. In like manner each end of the room has its pilaſters of the ſame order, one on each ſide of the fire-place, and of the doors. The cove and ceiling are richly ornamented in paintings and gold.

A room of this deſcription is not, however, a proper precedent for drawing-rooms in general, as it partakes principally of the character and ordinance of a ſtate ſaloon-room, in which are entertained ambaſſadors, courtiers, and other perſonages of the higheſt ſtations.

In the drawing-room which is here ſhewn, every thing will appear eaſily underſtood to a workman in town, who is accuſtomed to ſee ſuch apartments; but for a ſtranger, and thoſe workmen who reſide in the country, it will be proper to point out a few particulars.

The pier tables have marble tops and gold frames, or white and gold. The glaſſes are often made to appear to come down to the ſtretcher of the table; that is, a piece of glaſs is fixed in behind the pier table, ſeparate from the upper glaſs, which

then appears to be the continuation of the ſame glaſs, and, by reflection, makes the table to appear double. This ſmall piece of glaſs may be fixed either in the dado of the room, or in the frame of the table.

The arches above the windows are merely artificial, being only wooden frames put up, ſtrained with canvas; after which the ſame kind of ſtuff which the curtains are made of is formed to appear like a fan, and drapery tacked on to it.

The pannelling on the walls are done in paper, with ornamented borders of various colours.

The figures above the glaſſes are paintings, in clare-obſcure. The ſofas are bordered off in three compartments, and covered with figured ſilk or ſatin. The ovals may be printed ſeparately, and ſewed on. Theſe ſofas may have cuſhions to fill their backs, together with bolſters at each end. In France, where their drawing-rooms are fitted up in the moſt ſplendid manner, they uſe a ſett of ſmall and plainer chairs, reſerving the others merely for ornament.

The commode oppoſite the fire-place has four doors; its legs are intended to ſtand a little clear of the wings; and the top is marble, to match the pier tables. In the freeze part of the commode is a tablet in the center, made of an exquiſite compoſition

poſition in imitation of ſtatuary marble. Theſe are to be had, of any figure, or on any ſubject, at Mr. Wedgewood's, near Soho-ſquare. They are let into the wood, and project a little forward. The commode ſhould be painted to ſuit the furniture, and the legs and other parts in gold to harmonize with the ſofas, tables, and chairs.

To ſupply the Defect of Figure 32, *Plate* V.

It is there ſhewn how to find the miter of the ſides of a comb-tray at any pitch, and of any given projection; but it was omitted to ſhew how the miter is obtained in the thickneſs of the ſtuff, as it riſes to any pitch.

Having found the breadth of the ſides *b c*, Fig. 32, Plate V, with this opening of the compaſſes deſcribe a ſemicircle, ſee Plate XXII, and make *a e* equal to the perpendicular height of the ſide of the tray. Draw a line from *e* to the center; and parallel to this, ſet off a line for the thickneſs of the tray ſides, and the bevel of the under edge will be at 4. Draw a ſquare at the center, the length of whoſe ſides ſhall be equal to the thickneſs of the tray ſides, as 3, 1, 2. Next draw the line B, A, E, parallel to the diameter; and take *a e*, the ſine of the angle of the tray ſides, and transfer it to E A. From A draw a line to the center, cutting the ſmall ſquare at 1, and the ſpace 1—2 will be the miter ſought for; that is, when the ſides are mitered in

their

their breadth, according to Fig. 32, Plate V, ſet a gage to 1—2, and run the gage along the miter, and plane it off to the gage from the outſide, and the miters will all come exactly together. If the tray ſides were raiſed to *b*, *b i* would then be the ſine of their angle; and which being transferred to B, a line from B to the center cuts the ſquare at 3; then is the ſpace 3—2 the length of the miter ſought. And thus it is evident, that as *b* advances to E the perpendicular, ſo will the miter point B approach to D, the full miter. It is alſo evident, that by this figure the miter of any thing not exceeding the diameter E of the ſemicircle may be found. For inſtance, if the ſides of any tray be half an inch thick, and it is required to be mitered and keyed together, draw a ſquare of that dimenſion, as the ſecond ſhewn in the figure; and if the ſides bevel in an angle equal to the line *e*, then 1—2 of the ſecond ſquare will be the length of the miter. I proved the truth of this theory by practice, and therefore the workman may depend on its infallibility; but he may eaſily make the ſame experiment himſelf.

THE END.

ERRATA.

Page 23, line 14, for *b s*, read *b* S.
—— 28, —— 13, *read it thus*:—if you want five tenths of a foot, and five of the hundredth parts of a foot, place your compass foot—
—— ib. —— 19, *for* any tenth part of an inch, *read* any one hundredth part of a foot.
—— 57, —— 16, *for* 9, 5, *read* 9—5.
—— ib. —— 18, *for* 9, 5, *read* 9—5.
—— 61, —— 11, for *a* to *n*, read *d* to *n*.
—— 70, —— 9, *for* the extreme line P E and P 1, *read* P E and I I.
——137, —— 4, *for* abacuo, *read* abacus.
——152, Plate VIII, *for* 7 diameters, *read* 8 diameters.
——162, line 22, Plate XII, *for* take *m o*, *read* take twice *m a* in the compasses, and with this opening find the center of the curve for the abacus as at *p* on Fig. B.
——206, —— 10, *for* from *a* to *a*, *read* from *d* to *a*.
——211, —— 11, *for* Plate XV. *read* Plate XIV.
——273, —— 15, *for* Fig. 23, *read* Fig. 21.

APPENDIX

TO THE

CABINET-MAKER AND UPHOLSTERER'S

DRAWING-BOOK.

CONTAINING

A VARIETY OF ORIGINAL DESIGNS FOR HOUSEHOLD FURNITURE, IN THE NEWEST AND MOST ELEGANT STYLE;

ALSO,

A NUMBER OF PLAIN AND USEFUL PIECES, SUITABLE EITHER FOR TOWN OR COUNTRY;

TOGETHER WITH A DESCRIPTION AND EXPLANATION TO EACH PIECE.

BY

THOMAS SHERATON,

CABINET-MAKER.

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1793.

APPENDIX.

Of the Elliptic Bed. Plate I. of the Appendix.

As fancifulneſs ſeems moſt peculiar to the taſte of females, I have therefore aſſigned the uſe of this bed for a ſingle lady, though it will equally accommodate a ſingle gentleman.

The elliptic ſhape of the frame of this bed contracts its width at each end conſiderably, on which account it will not admit of more than one perſon.

On the manufacturing part of it I would offer a few hints to aſſiſt the workman.—The frame of the bedſtead ſhould be glued up in wainſcot three or four thickneſſes, with the jump-joints croſſing each other, as in the method of gluing the frames of circular card-tables, which ſome uſe. For which purpoſe, draw the full ſize of the ellipſis upon a board, and make the diameters each way, by which one quarter will be found.

found. A thin mould muſt then be made to agree with the quarter of the ellipſis, which will ſerve for cutting out the whole by, when different portions of it is ſo taken as to form croſſing-joints. The frame being thus made an entire ellipſis, as Fig. A, in Plate XXX. it is propoſed to half-lap the pillars into the frame, and to have a ſtretching rail at each end to tenon in oppoſite to each pillar; into which ſtretcher the ſcrews are to work which fix the pillars to the frame, as ſhewn at *a*, *b*, *c*, *d*, in Fig. A. The workman will eaſily ſee that the frame made in this manner will not be defective in ſtrength, nor inconvenient to move from one room to another.

The ſtuffed head-boards at each end are framed ſeparate, and grooved into the pillars, with a tenon in their center to ſlip into the bed-frame, which can be eaſily done when the pillars are ſcrewing to.

The firſt teſter which fixes on the pillars, ſhould form an entire ellipſis to ſuit the frame, and muſt be glued up in two thickneſſes of good deal or wainſcot; to the edge of which ſhould be glued two thickneſſes of clean ſoft mahogany, of which to work the cornice, as expreſſed by Figure B, in Plate XXX.

The ſecond, or falſe teſter, is that to which the ribs of the dome part are fixed, as *e* in Fig. B; and *f* is an architrave which is bent round the inſide of the firſt teſter, and riſes ſo high above it as to receive nearly the thickneſs of the falſe teſter; ſo that the architrave is a guide to the whole dome, and is ſuffici-ent of itſelf to keep it firm in its place.

With reſpect to the dome, it will be beſt to make it in two parts. The cove part ſeparate, and the round or ſpherical part ſeparate. This can eaſily be done, by repeating the ſame ope-rations as were neceſſary for fixing and managing the cove part; for it muſt be obſerved, that there is a light cornice or moulding where the circular part of the top begins, and which fixes on a teſter in the ſame manner as the other. To the under ſide of this cornice is the drapery, which hangs in the cove, tacked all round, as is the valence to the under cornice. The curtains are drawn up by pulleys fixed in the under teſter, and thus forms a drapery, by being tied to the pillars with cords.

The circular part of the top is intended to be pannelled out in gilt mouldings, which cannot fail of producing a fine effect, particularly ſo if the furniture and covering of the dome be light blue. The foliage ornament that runs round the under cornice may be made either of compoſition metal, or it may be cut in

wood and fixed on wire, in the fame manner as the tops of ornamented glaffes are managed.

Of the Ducheffe.

THE French have what they term ducheffe beds, whence I fuppofe we have derived our ideas of a ducheffe. What is fometimes named a ducheffe amongft us, is merely two barjier chairs faftened to a ftool in the middle; fometimes, indeed, we add a flight tefter and covering, but even this is very different from theirs. The French ducheffe beds are more ftately. The tefter is full and fixed to the wall, with drapery hanging down to the bedding and floor. The head part is formed fomething like the back of a chair; at the foot there are fhort ftump pillars; and the whole frame of the bed being detached from the tefter, may be moved to any part to loll upon. The ducheffe which is here given, is intended to anfwer three different purpofes. The ends, when detached from the middle ftool, may ferve as fmall fofas. When they are connected together without the tefter, and a fquab or cufhion made to fit over the whole, it will then ferve to reft or loll upon. When it is ufed as a bed, four fhort pillars are fcrewed to each back foot, and a ftraight lath extends acrofs from pillar to pillar at each end. From thefe pillars are fixed the fweep iron rods which form the tefter, and which fupport the

the drapery and covering which is thrown over the whole. The little dome or top is made ſeparate and entire of itſelf, with the cornice mitered round, and the taſſels fixed to it as ſhewn in the deſign, and the whole is placed looſe on without any faſtenings.

They are made narrow, between two and three feet wide, and ſeldom above it. Every thing is made exceeding light about the teſter. The ſtool is fixed to each chair with ſtraps and buttons, and the whole thus finiſhed makes a pleaſing appearance.

Of the Library Caſe. Plate III. of the Appendix.

THE elliptic breaks of this bookcaſe will produce a good effect in the whole.

The doors in the upper part are intended to have fluted green ſilk behind, and a drapery at top.

The pilaſters are ſuppoſed to be glued to the ſtile of the door, and are hinged as in common.

The lower middle part contains clothes-preſs ſhelves, and every other part may be fitted up for books; or the lower elliptic

tic breaks may be formed into a neſt of drawers, as there is depth enough.

The half columns on the lower doors are glued to the ſtile, and the doors hinged as in common; but for the ſake of ſhewing the deſign to advantage, the open door is drawn as if the columns were ſeparate.

The young workman ſhould obſerve, that the whole is to be made in ſix carcaſes, and ſcrewed together, and then the plinth ſhould be made to fit it, of one entire frame; alſo the ſurbaſe and its freeze are made all in one frame, and ſcrewed down on to the carcaſes; as alſo is the cornice and its freeze.

Of the Pier Tables. Plate IV.

As pier tables are merely for ornament under a glaſs, they are generally made very light, and the ſtyle of finiſhing them is rich and elegant. Sometimes the tops are ſolid marble, but moſt commonly veneered in rich ſatin, or other valuable wood, with a croſs-band on the outſide, a border about two inches richly japanned, and a narrow croſs-band beyond it, to go all round. The frames are commonly gold, or white and burniſhed gold. Stretching-rails have of late been introduced to theſe

tables, and it muſt be owned that it is with good effect, as they take off the long appearance of the legs, and make the under part appear more furniſhed; beſides they afford an opportunity of fixing a vaſe or baſket of flowers, which, with their reflection when there is a glaſs behind, produce a brilliant appearance.

Some, in place of a ſtretcher, have a thin marble ſhelf, with a braſs rim round it, ſupported by a light frame; in which caſe the top ought to be of marble alſo.

Of the Library Steps and Table. Plate V.

THIS deſign was taken from ſteps that have been made by Mr. Campbell, Upholſterer to the Prince of Wales. They were firſt made for the King, and highly approved of by him, as every way anſwering the intended purpoſe. There are other kinds of library ſteps which I have ſeen, made by other perſons, but, in my opinion, theſe muſt have the decided preference, both as to ſimplicity and firmneſs when they are ſet up. The ſteps may be put up in half a minute, and the whole may be taken down and encloſed within the table frame in about the ſame time. The table, when encloſed, ſerves as a library table, and has a riſing flap, ſupported by a horſe, to write on. The

ſize

ſize of the table is three feet ten inches long, thirty-three inches high, and two feet one inch in width. When the ſteps are out they riſe thirty-three inches perpendicular from the top of the table frame, and the whole height of the laſt ſtep is five feet five perpendicular from the ground. The perpendicular height of the hand-rail is three feet one inch above the laſt ſtep; and obſerve, that on *g*, which is iron, is fixed a ſmall flap on which a book may reſt, ſo that a gentleman, when he is looking at any book in his library, may note down a paſſage from it without the trouble of going down again. The method of folding the whole up is as follows:

The triangular iron bracket *g* is unlocked by a catch which keeps it firm to the hand-rail, and the deſk-flap fixed to it being turned over to the inſide, the whole comes forward, and lies level upon the upper ſteps. The ſtandard *b* may then be raiſed out of its ſocket, and, having a joint at the top, it turns up to *d*, as ſhewn by the dotted curve line. The ſhort ſtandard *d e* is then, by relieving a ſpring, preſſed down below the edge of the table-top; and the hand-rail and ſtandard *b* having been folded together, as mentioned before, they both reſt on the iron ſocket faſtened to the front edge of the upper ſteps. Next, the horſe *o* is folded by the ſide of the upper ſteps, and then both they and the horſe fall down within the table frame; and it muſt be obſerved, that in folding

ing down the ſteps, the hand-rail and ſtandard, which reſted for a while on the ſocket faſtened to the front of the ſteps, fall into another ſocket of the ſame kind faſtened to the under ſide of the table top, where they remain, and fall within the table frame when the top is folded down. Laſtly, the lower ſteps *a* are turned up to a horizontal poſition, and being hinged to a ſlider which runs in a groove, the whole ſlips in as a drawer, and is encloſed by the flap *p*, which turns up and appears as the front of a drawer.

Of the Drawing-room Chairs. Plate VI.

THE frame of the right-hand chair is intended to be finiſhed in burniſhed gold, and the ſeat and back covered with printed ſilk.

In the front rail is a tablet, with a little carving in its pannel. The legs and ſtumps have twiſted flutes and fillets, done in the turning, which produce a good effect in the gold.

The chair on the left may be finiſhed in japan painting, interſperſed with a little gilding in different parts of the baniſter, which has a lively effect. The covering of the ſeat is of printed

chintz, which may now be had of various patterns on purpofe for chair-feats, together with borders to fuit them.

Of the Bidet Dreffing-Table, and Night-Table Bafon-Stand. Plate VII.

THE dreffing-table has a real drawer under the cupboard part, and the reft are fham.

The right-hand cupboard door opens by a fpring-catch communicated to the patera handle in the center. The water-bottle is fupported by a round box, made of very thin wood, glued and canvaffed over to ftrengthen it, and fixed to the top.

The bidet legs turn up with a joint. The defign fhews only legs at one end, but the other legs are fuppofed to be folded up till the whole is taken out; and when ufed, the legs are kept to their place by iron hooks and eyes.

The fcale fhews the fize of the front, and its depth from front to back is fixteen inches and a half. The frame, to which the glafs is hinged, is fourteen inches in width.

The night-table requires no explanation, and I fhall only obferve, that the covers with rings on them are meant for

a tooth-

a tooth-bruſh, and the ivory boxes on the right for tooth-powder.

The ſcale for the dreſſing-table ſhews the ſize of the night-table, applied to the front, and its depth from front to back is eighteen inches.

Of the Wardrobe. Plate VIII.

THE upper middle-part contains ſix or ſeven clothes-preſs ſhelves, generally made about ſix, or ſix inches and an half deep, with green baize tacked to the inſide of the front to cover the clothes with. The lower part conſiſts of real drawers. The wings have each of them arms, to hang clothes on, made of beech, with a ſwivel in their center, which ſlips on to an iron rod fixed by plates ſcrewed on to each ſide of the wings, as expreſſed in the deſign.

The whole is made in four ſeparate carcaſes. The wings by themſelves, and the upper and lower middle parts ſeparate.

The plinth is made all in one frame, and likewiſe the cornice with its freeze, and being ſcrewed to each carcaſs, the whole is kept firm.

Obſerve, that in the wings a bead is put up for the doors to fall againſt when they are ſhut to; by which means are cleared the knuckles of the hinges on the doors of the middle part.

It ſhould alſo be obſerved, that as the ſurbaſe cannot go round the out ends of each wing on account of opening the doors, the moulding is returned againſt the front of each door.

The ſurbaſe on the middle part returns, and ſtops againſt the inner end of the wing; and the edge of the door of each wing, with the ſurbaſe which is on them, are ſcribed on to the aforeſaid return, which then appears as an internal miter, and gives place to the opening of the door.

The ſcale, applied to the middle part, gives its height and length. The wings are two feet, and ſixteen or ſeventeen inches deep; and the depth of the middle part about twenty-three inches.

Of the Bed. Plate IX.

THIS deſign requires no explanation, except that which relates to the teſter. The cove of the teſter is to be formed by

ribs; one at each miter, and other ſhort ones joined to them, with the reſt about five inches apart from each other. At the upper part of the cove is a ſquare teſter into which the ribs are fixed. On the edge of this teſter, which is made very light, is fixed a ſmall moulding mitered all round. The cove being formed, the ribs may be covered with ſtrong board-paper, both inſide and out, which may either be japanned to match the furniture, or it may be covered with the furniture itſelf. The circular part about the cove is nothing more than a ſtraight board fixed on to the upper teſter. For the ſake of eaſy conveyance, the cove may be made in four parts, mitering at each corner, and the ornament intended to be at each miter on the outſide running entirely up to the feathers, will hide the joint.

The ſwags of ſilk line that appear on the drapery ſhould be faſtened to the back part of the cornice, in order that they may hang eaſy. The pillars are to be japanned. The pannel that hides the ſcrews is made to ſlip into a groove at the bottom, and when raiſed up a little from their place, can be taken away to come at the ſcrews. The valence and drapery both together ſlip on to a lath as in common.

Of the Sofa and Converſation Chairs. Plate X.

WITH reſpect to this ſofa, all that is neceſſary to be obſerved is, that in the ſpace between the diviſions of the back part, it is meant that there ſhould be a ground-work covered with ſilk, to ſuit the reſt of the ſofa. Againſt this ground the two columns and the ornament are ſuppoſed to reſt.

The converſation chairs are uſed in library or drawing-rooms. The parties who converſe with each other ſit with their legs acroſs the ſeat, and reſt their arms on the top rail, which, for this purpoſe, is made about three inches and an half wide, ſtuffed and covered.

For the convenience of ſitting in the manner juſt mentioned, the chair is made long between front and back, and very narrow at the back and front in proportion. The height of the chair to the ſtuffing is three feet; at the back ten inches, ſpreading out in width to the top rail, which is twenty inches in length. The front is ſixteen inches, and the height of the ſeat as in common.

Of the Card Tables. Plate XI.

ON thefe tables it is fcarcely neceffary to fay any thing, efpecially as the quarter plans fhew how they muft be framed; and therefore I fhall only obferve, that the ornaments may be japanned on the frames and carved in the legs. As to the method of managing the tops, I take it to be the beft to rip up dry deal, or faulty mahogany, into four inch widths, and joint them up. It matters not whether the pieces are whole lengths, provided the jump-joints be croffed. Some tongue the jump-joints for ftrength.

After the tops are dry, hard mahogany is tongued into the ends of the deal, then flips are glued on the front and back, that the whole may appear folid mahogany, if a moulding is to be worked on the edge; but if the edge be crofs-banded there is in this cafe no need for tonguing in mahogany.

Of the Library Table with a Writing Drawer. Plate XII.

THIS table is intended either to fit or ftand and write at. The height of the fecretary-drawer is adjufted for fitting, and

the top of the table is high enough to ſtand and write on, eſpecially if the middle top be raiſed by a horſe, as ſhewn in the deſign. This table will alſo prove very uſeful to draw on; for when the middle part is up for drawing upon, there remains ſufficient room at each end of the table on which to place the neceſſary impliments for drawing; beſides, the drawers at each end may be fitted up to hold colours of various kinds; I mean the two upper ones, for there are drawers quite down to the plinth. The drawers under the ſecretary will hold the large ſheets of drawing-paper, together with the tee ſquares; and as it will not be neceſſary to make the drawers under the ſecretary the entire width of the table, the oppoſite front, being made ſham to have the ſame appearance, the whole of it may be hinged at bottom and locked at the top, and the inſide will allow depth for books. This ſham front being a conſiderable width, it would hazard the hinges to let it reſt wholly on them when turned down, and therefore there ſhould be iron rule-joints at each end as ſtays.

To theſe conveniences there are alſo four cupboards incloſed with doors, as ſhewn in the deſign, and the whole finiſhed in this manner, I venture to affirm, will prove as uſeful a table as has ever been deviſed or publiſhed.

In

In reſpect to the manufacturing part, it will be beſt to make it in two parts. The upper part containing the ſecretary, and two drawers at each end; and the lower part, four drawers under the ſecretary, a book-caſe behind, and four drawers at each end, the lowermoſt of which is ſhewn in the deſign. The top ſhould be framed of inch and quarter wainſcot (as deſcribed in page 373), containing a well for the deſk part, which may be made to riſe on the front as well as at the back, by forming a double horſe; but in this deſign it is only intended to riſe at the back by a ſingle horſe, and hinged to the croſs-band at the front.

The cupboard doors may either be framed and pannelled, or glued up to their ſweep in narrow ſlips of inch mahogany, and clamped; not by tonguing, but by a ſquare joint, and pins driven through the clamps.

The management of the circular baſe-moulding and plinth may be learned in page 375.

Of the Fire Screens. Plate XIII.

THE lyre ſcreen is conſtructed upon an entire new plan, it being deſigned to turn upon a ſwivel, which fixes to the vaſe

and

and paſſes through the bottom rail, ſo that the ſcreen may be turned to any poſition without moving the ſtand.

The ſcreen part, which riſes between the ſtandards or pillars, is ſuſpended by a weight in the taſſels, which are communicated to the ſcreen by a line paſſing through the pillars and over a pulley fixed to their top.

There muſt be a dovetail groove in each ſtandard, and the ſcreen made to fit into theſe; ſo that the ſtandards may keep their proper place, and not fly open at the top.

Obſerve, that the ornament on the tops of the pillars or ſtandards riſe up with the ſcreen, being fixed to it, and detached from the pillars.

It is intended that the lyre ornament be carved in bas relief, gilt and burniſhed; which, when planted on to a blue ſilk or ſatin ground, cannot fail to produce a fine effect.

The other ſcreen being common, needs no explanation, only that it is ſuſpended by little ſprings fixed in the dovetail grooves of the ſtandards.

In refpect to the general fize of horfe fire-fcreens, about eighteen inches or nineteen may be allowed for the breadth, and three feet fix or feven inches for their height.

Of the Cabinet. Plate XIV.

THIS cabinet, I prefume, is as new as the fire-fcreen, and will have a better effect in the execution than in the defign.

The front of the cabinet is hinged to a fliding piece which runs in a groove, upon the fame principle as the writing-table page 408. The front being turned down to a horizontal pofition, it may then be flipped in till it ftops. To fupport the front thus turned down, there are two fliders which come out of the plinth on which the cabinet refts. Thefe fliders come out by relieving a fpring which is fixed in their fide, and having a common fpring behind, they are forced out fo that the fingers may lay hold to draw them quite out. They are lined with green cloth both at top and bottom to prevent fcratching. The infide of the front is alfo lined with green cloth to write on. The infide of the cabinet is fitted up in the manner fhewn in the cabinet Plate XVI.

Above the falling front is a drawer, to the under ſide of which the front locks, ſo that the drawer and front are either locked or opened at one time.

Above the drawer is an ornamented freeze, japanned; and round the top, which is marble, is a braſs edging.

The flower-pot at the top is ſuppoſed to be real, not carved; but that on the ſtretcher is carved.

The columns ſtand clear, as ſhewn by the plan; and they are intended to have braſs baſes and capitals, with wooden ſhafts fluted.

The candle branches turn to any form in a ſocket, and the whole may be taken away, as they are only ſcrewed into a nut fixed into the legs of the table.

There is a braſs fret fixed at each end, which finiſhes at the ſtandards of the candle-branches. The lower frame contains a drawer in front, and the legs being octagon, are intended to be veneered croſſways as far as to the carving, which may be gilt to ſuit the baſes and caps of the columns.

Of the Dreſſing Cheſts. Plate XV.

THESE cheſts are alſo on a new plan, particularly as the common-ſlider for merely writing on is turned into a ſhallow drawer, which contains a little writing flap which riſes behind by a horſe, and places for ink, ſand, and pens, and alſo dreſſing-boxes. When the drawer is in, it appears like a common ſlider, with a partition above and below, as that with the convex front. There is therefore no ſlip under the top, as the drawer ſides muſt run cloſe up to it. The drawer below of courſe muſt lock up into the under edge of the dreſſing-drawer, and the dreſſing drawer into the top, which is done at one time, by the bolt of the under lock forcing up that of the upper one.

The height of theſe cheſts are always governed by the ſlider, which runs thirty-two or thirty-three inches from the floor. The ſcale ſhews their length, and their breadth is twenty-two or twenty-three inches.

Of the Lady's Cabinet. Plate XVI.

THE cabinet in Plate XIV. is made in two parts, but this is entirely in one. The legs and columns are therefore all in one piece

piece. The inſide of the cabinet is made ſeparate, and ſlips in between the legs, and a piece of narrow wood, as a band, is fitted to fill the ſpace up to the column, as the deſign ſhews.

The marble ſhelves, with frets at each end, are for a tea equipage. Above and below theſe ſhelves are drawers which turn out by a hinge. Above and below the front are alſo drawers. The drawer below may be made to ſupport the front when turned down to write on, or it may be ſupported by braſs joints, as ſhewn in the deſign for the inſide of the cabinet.

The ſcales and plans of each cabinet ſhew their length and breadth; it remains only to mention their height, which is four feet, and four feet two.

Of the Horſe Dreſſing Glaſſes. Plate XVII.

THE dreſſing-glaſs on the left riſes to any height, by lead weights incloſed in the ſtandards. The weights are ſuſpended ſometimes to tambour glued on to webbing, which paſſes over a braſs roller at the top, and fixes to a piece of thin wood, tamboured to match it. Through this piece of thin wood is put an iron pin, with a thin plate to it to ſcrew it faſt; which pin goes through the ſide of the glaſs, and faſtens by a nut at the inſide,

ſo that when the glaſs is raiſed, it may be turned to any direction. But ſome uſe a kind of coloured ſtrong webbing, without the tambour, which makes it leſs troubleſome, and leſs liable to injury, though it does not look ſo neat. Thoſe unacquainted with the manner of gluing up the ſtandards, may ſee a ſection of them in Plate XXX. Fig. C.

There is a braſs handle behind the ornamented top to raiſe the glaſs by.

The boxes on each ſide are intended to hold conveniences for dreſſing. On theſe, there is a comb-tray on the left ſide, and a pin-cuſhion on the right. When the dreſſing-boxes are not in uſe, they are intended to turn behind the glaſs. For this purpoſe they are fixed to a braſs ſocket, which turns upon a ſhort braſs rod, and by a ſcrew they may be raiſed up or lowered at pleaſure. See Fig. D. Plate XXX.

The other dreſſing-glaſs has a convenience for writing as well as for dreſſing, which convenience riſes by a little horſe. The dreſſing-boxes are made with cloſe covers, and a ſlider incloſes the whole, ſo that when the whole is turned up nothing can come out of its place. The glaſs does not riſe as the other, but fixes in centers, ſo as to move in any poſition either back or forward.

And obſerve, that when the dreſſing-flap is turned up it locks into the top rail, and the glaſs of courſe falls to its own place. The under ſide of the flap being the front when turned up, it may be japanned and banded. The lower parts of the ſtandards are ſhaped like a lyre; and to form the ſtrings, braſs wire is let in, which has a pretty effect.

Of the Chaiſe Longus. Plate XVIII.

These have their name from the French, which imports a long chair. Their uſe is to reſt or loll upon after dinner, and in ſome caſes the lower one will ſerve for a ſofa. The drapery under the rail is tacked to a rabbet left on purpoſe. The upper one is framed firſt in two parts. The end, or chair part, is made to receive the ſtool part within its ſides; and the ſides of the ſtool part ſcrew in againſt the inſide of the chair. As to any other particular, the deſigns themſelves are ſufficient to point them out.

Of the Engliſh State Bed. Plate XIX.

In giving a deſign for an Engliſh ſtate-bed, or ſuch an one as is ſuitable to the dignity of a prince, and worthy the notice of a king, I conceived it neceſſary to cultivate as much as I could the

the moſt exalted ideas, unfettered and unreſtrained with the thoughts of expenſiveneſs, which naturally produces meanneſs of compoſition, and in many caſes injures the ingenious in their deſigns.

For ornament to a bed of this kind, it ſtruck me that nothing could be more ſuitable and characteriſtic than ſuch as expreſſed ſymbolically the different parts of our government, together with thoſe virtues and principles which ought to be the ſupport of regal authority, and the ruling maxims of every good government of whatever kind, whether monarchical, ariſtocratical, or democratical. Emblems of war have been avoided as much as poſſible, being inconſiſtent ornaments for a bed, and becauſe good kings ought not to delight in war, but in peace, unity, and the love of men and their ſubjects.

As our government is compoſed of three diſtinct branches, the figure on the right hand bed-pillar is intended to repreſent the democratic part of it, or the power of the people inveſted in their repreſentatives in parliament.

In iconology*, democracy † is repreſented by the figure of

* Iconology, from εικον, *eikon*, an image; and λεγω, *lego*, I ſpeak. The interpretation of ancient images, monuments, and emblems.

† Democracy, from δημος, *demos*, people; and κρατειν, *kratein*, to command or govern; is when the ſovereign power is lodged in the body of the people.

a woman

a woman dreffed in a homely garment, and crowned with vine leaves. In her right hand fhe holds a pomegranate, which denotes affemblies of the people on matters of importance. In her left hand is a clufter of ferpents, which expreffes the winding and flow progreffion of democratic ftates, owing to the inability of the common people to govern. Her ftanding on the two facks of corn which reft on the pedeftal, fignifies that democratic government is more attentive to the obtaining of neceffary provifions, than the increafe of fame, or the acquifition of honours. If this be a juft reprefentation, and founded on fact, the reader will, no doubt, confider the democratic branch a very important one, and for which reafon it is here placed near the groundwork.

The figure, oppofite, on the left pillar, reprefents the ariftocratic branch. Ariftocracy* is defcribed by the figure of an elderly lady, in a fumptuous drefs, with a crown of gold upon her head. Painters reprefent her fitting on a throne; which is a pofition confonant to lawgivers, but which I could not make fuitable to this fituation. In her right hand fhe holds the confular fafces, that is, a number of elm rods tied in a bundle, with a hatchet in the middle, which, originally, were the enfigns of

* Ariftocracy, from ἄριστος, *ariftos*, the beft; and κρατέω, *kratio*, I command or govern; is when the fupreme power is lodged in a fenate, compofed of the principal perfons of a ftate, either for their nobility, capacity, or probity.

ſovereign dignity, but in after times the hatchet was taken out, and they were carried before the conſuls or magiſtrates of Rome, to denote their authority. Theſe rods are entwined with a crown of laurels, a ſymbol of reward due to thoſe who have maintained the public welfare, and have performed great actions for the good of the ſtate. In her left hand is a ſteel cap, at her feet a hatchet, a plate, and purſe with money, all which denote that arms and finances are neceſſary ſupports of ſtates. And I would here obſerve, that it is not abſolutely neceſſary to conſider the ſteel cap and hatchet as ſymbols of war, but of the executive power requiſite in all governments for the maintenance of peace, and the puniſhment of evil doers.

The figure in the center of the upper cornice is intended to repreſent the monarchical branch of our government.

Monarchy * is characterized by the figure of a young woman of grave countenance, ſeated on a terreſtrial globe, holding four ſcepters, to denote dominion and power. The other hand being uplifted, denotes her authority in giving command. The rays of light ſurrounding her head, denote luſtre, and the reſpect due to her greatneſs. The lion on each ſide ſymbolizes the

* Monarchy, from μονος, *monos*, alone; and αρχη, *arche*, government; is when the ſupreme power is inveſted in one perſon, commonly termed the King.

power which ſhe poſſeſſes and requires of others in order to her ſupport. Painters, however, deſcribe her with trophies of war, and a crowned head chained down as a captive at her feet, which I have here omitted, hoping that conqueſt and war are not the prominent features in our government.

Theſe three figures in their ſituation to each other form a triangle, whoſe baſe is democracy and ariſtocracy, and whoſe ſummit is monarchy; denoting that monarchical power and honour are originally derived from the people, and that without their ſupport, monarchy in its moſt exalted ſtate muſt fall.

The lions which ſupport the bed, with oak foliage and leaves on the bed-frame and round the ſhafts of each pillar, are emblems of the ſtrength and permanent nature of our government. The acorns being the fruit of the oak, denote, that by long progreſſive improvements it is arrived to a good degree of maturity.

The ſerpents in the cornice, which mutually entwine themſelves round Mercury's rod, denote the unity, prudence, and wiſdom, requiſite to monarchs in the exerciſe of their important charge. The trumpets and laural crown are expreſſive of the fame which the Engliſh ſtate has acquired through the mildneſs of its government. The beads under the cornice denote

note its riches. The baſkets of fruit on each capital, and in the quadrantal pannels, ſymbolize the proſperous ſtate of the nation, and the plenty we enjoy. In the arch of each quadrant are marked the degrees, to denote that navigation has contributed greatly to our riches and ſafety. The lyre and trumpets on the pedeſtal above the cap, ſignify the flouriſhing ſtate of the arts; and the ſpreading oak leaves and roſes, are meant to expreſs the deſigner's wiſh and hopes, that the uſeful arts may long continue to grow and ſpread themſelves under the munificence of our government.

The coronets round the dome are thoſe of the immediate ſons and daughters of the king of Great Britain, of which there are thirteen; but the dome being divided into ſixteen compartments, ſtill leaves room for an increaſe of the royal family, to denote that the ſubjects of Great Britain ſhould hope for a long ſucceſſion of a mild and good government. The feſtoons of flowers denote that happineſs and proſperity are wiſhed to ſurround each branch of the royal offspring.

The crown of England is ſupported on the top of the dome by three figures, intended to repreſent Juſtice, Clemency, and Liberty; for notwithſtanding theſe may, in ſome inſtances, be ſullied in our government, yet ſcarcely any nation can boaſt of more than that which we have long enjoyed.

Juſtice, which ought to be the moving principle of civil government, is by painters deſcribed by the figure of a woman dreſſed in white robes; holding in her left hand a ſword, to puniſh criminals; and in her right a pair of ſcales, to give that which is due to every one without partiality; which impartiality is denoted by a bandage over her eyes. In this ſituation the ſword and ſcales may be ſuppoſed to lie on the other ſide of the dome ready for uſe.

Clemency is a neceſſary quality or principle in government, by which thoſe in authority are enabled to take into conſideration, and to effect the relief of the miſeries of the helpleſs and inſolvent. In the exerciſe of this virtue, he who is ready to be cut aſunder by the uplifted hand of juſtice can be ſaved, and the rotting inſolvent priſoner can be abſolved and releaſed. Such actions beget gratitude in the minds of the ſubjects, and are as a pillar to the crown; while cruelty and tyranny have often proved fatal to princes.

Painters deſcribe this virtue by the figure of a woman crowned with olives, as a mark of her peaceful and gentle temper; and dreſſed in a purple robe, which denotes her eminence. She is characteriſed by the mildneſs of her countenance, and ſitting on a lion (which I could not here introduce.) She alſo holds a laurel branch of honour and reſpect in her right hand.

She

She is ſaid to have a ſpear by her ſide, ſo that when her mercy is abuſed ſhe may in juſtice revenge it.

The other figure, Liberty, on the other ſide of the dome, is an eſſential principle to good government. It ſuppoſes a diſpoſition in thoſe poſſeſſing ſupreme authority to allow ſubjects to enjoy their natural, moral, and religious rights. In the poſſeſſion of theſe we are delivered from ſlavery; the yoke is broken. Therefore painters repreſent liberty by the figure of a woman, with a broken yoke-ſtick in her left hand, and trampling upon it as a mark of reſentment. She is dreſſed in white robes, to denote the bleſſings which ſhe confers on mankind; and in her right hand ſhe holds a ſceptre as a ſign of independence. She has alſo a cap of liberty on her head, in alluſion to the cuſtom of the Romans, in ſetting their ſlaves free; who alſo ſhaved their heads, and permitted them to be covered in the preſence of thoſe who gave them liberty *.

The figures on the other ſide, and at the end of the bed may be the ſame, not merely for uniformity's ſake, but to convey the ſentiment expreſſed by the allegory with more weight, as it is well known that repetition is ſome-

* Richardſon's Iconology, from whoſe work I am indebted for ſeveral ideas on this ſubject.

times introduced to give force and energy to a ſubject. However, if any ſhould think it neceſſary to vary the figures on the different ſides, there are plenty of ſubjects ſuitable enough.

Fortitude may be placed on the center of the cornice, oppoſite to monarchy; to denote a quality of mind ſo highly neceſſary in thoſe who rule. The emblem of this quality is a woman reſting on the ſhaft of a column and its baſe, having a brown robe and part of a military dreſs, with a lion on one ſide of her; but ſhe may have one at each ſide, to make the outline more agreeable to the figure of monarchy. Her military dreſs conveys the idea of courage; and reſting on a column, ſteadineſs and firmneſs; and the lion, ſtrength of mind.

On the bed-pillar, oppoſite to the figure which repreſents the ariſtocratic branch of our government, ſhould be Counſel, to denote the wiſdom and ability neceſſary in thoſe who make up that branch.

Counſel is repreſented by the figure of a grave old man, having a long beard, dreſſed in long robes of violate colour. His age denotes that experience requires length of time, and that wiſdom is the reſult of experience. His long robes denote

his

his high character, and their colour his gravity. He is represented sitting, to shew his authority; and with a chain of gold round his neck, to which is suspended a human heart, to denote his integrity. In his right hand is a book, to shew he has regard to law, and that from literature he obtains his knowledge. He may, however, in this situation be standing, as the bed-pillar will not so well admit of a sitting attitude; and in this attitude he may have a mirror in his left hand, surrounded with serpents, to denote prudence and speculation, as necessary to good counsel.

On the other pillar, opposite to the figure which represents the democratic branch of our government, there may be the emblem of Law, to denote that the members of parliament, as the representatives of the people, ought to be acquainted with the rights and interests of their constituents; and also, that in their debates on these subjects, they ought to regard the laws of the constitution.

Law is represented by the figure of a respectable elderly lady, sitting on a tribunal chair. Her age denotes that law is an ancient subject; she is seated to denote eminence, and holds a sceptre in her right hand to denote authority. In her left hand she holds an imperial crown, allusive to the law of nations,

importing that no nation can exiſt without laws. Her head is adorned with diamonds, to ſignify that law is moſt precious, and that its origin was from God.

At the end of the bed, and next to law, Obedience or Subjection may be introduced, to denote the duty and reſpect which the people owe to their repreſentatives whom they have appointed, and particularly to ſignify that ſubjects ought not to rebel againſt government.

Obedience is deſcribed by the figure of a humble woman, in an upright poſition, with her eyes towards heaven, to denote her regard to its commands as the Appointer of government. Her upright poſition not only ſhews her willingneſs to obey, but that government was never appointed to oppreſs or bow down the backs of thoſe who are willing to obey juſt laws. She is dreſſed in white robes, denoting innocence; and acroſs her ſhoulders is a yoke, the emblem of patience and obedience. By her ſide may be repreſented a dog, which is a ſymbol of obedience and faithfulneſs.

On the center of the cornice may be repreſented Authority, to denote that without its influence law is rejected and contemned,—obedience is without foundation, and therefore government could not exiſt.

Authority

Authority is reprefented by the figure of a matron, or old lady, to fhew that the inftitution of authority which gives effect to laws is ancient as law itfelf. She is feated on a regal chair, becaufe princes and magiftrates generally perform their office fitting, indicating tranquillity of mind. She holds a fceptre in her left hand, denoting regal power and authority; and by her fide are arms, to fignify her power to punifh the licentious, and protect the obedient. In her right hand is a book, refting on her knee, to denote that civil authority is of divine origin*.

On the other pillar may be the reprefentation of Tyranny chained down, with her back bowed, to fignify that thofe in authority ought to fupprefs rather than cherifh it; and to fhew that tyranny ought, in all good governments, to be at the foot of power, to prevent its baneful effects in a ftate. The emblem of this noxious quality is a pale, proud, and cruel-looking woman, dreffed in armour, and purple drapery, to denote her readinefs to fhed blood in the defence of her arbitrary meafures. In her left hand is a yoke, and in her right an uplifted fword, to fhew that fhe is ready to enflave mankind, and punifh them if they will not put on the yoke. She wears an iron crown, to fhew that the authority which tyrants feek is for bafe purpofes and cruelty.

* See Rom. xiii. 1.

To make theſe three figures harmonize—Authority, at the top of the cornice, may be repreſented as looking towards Obedience with an eye of approbation; and the book lying on her lap, with the right hand ſhe may hold a dart pointed directly to Tyranny below. And to repreſent Tyranny in the moſt wretched ſtate, her iron crown may appear to tumble off her head, her yoke broken, and her ſword pointed to her own breaſt, to ſhew that in the end tyranny is her own executioner. Thus, I think, the end of the bed will exhibit emblematically the end of civil government, which is to protect the innocent and obedient, to ſuppreſs cruelty and oppreſſion, which are the life and ſoul of tyranny. The front ſide ſhews the nature of our government, the dome the principles which ſupport it, and the back ſide the way in which government is managed.

The ornaments on the head-board are emblems of love and continency, expreſſed by the figure of Cupid, Chaſtity, and a trophy below. Cupid is repreſented as drawing his bow to guard Chaſtity from the violent attempts of Impurity, whoſe figure, partly a woman and partly a monkey, is behind the curtain, to denote that ſuch as practiſe it lurk in ſecret.

The emblem of Chaſtity is the figure of a young woman in white robes, to denote purity and innocence. Her head is crowned with a garland of cinnamon, a pleaſant and coſtly plant,

to ſignify that Chaſtity is a virtue both pleaſant and valuable. She is veiled, to expreſs her modeſty; and in her right hand holds a ſcepter, as a ſign of her conqueſt over luſt. In her left ſhe holds a turtle dove, which is an emblem of continence.

With reſpect to the manufacturing part of this bed, it ſhould be obſerved, that the curtains draw up by a pulley at the ſeveral corners, detached from the drapery valence which is fixed to the cornice.

The teſter on which the dome reſts, is made perfectly ſtraight, and forms an even ſurface on both ſides; which, in the inſide, is pannelled out with gilt moulding at each angle.

The quadrantal pannels recede back from the cornice, and are framed into the top of the pillars, which are left ſquare. The ground of theſe pannels being continued the whole length, from pillar to pillar, ſerves as a facia on which to fix the cornice. Then obſerve, that the baſket of fruit and the lyre being in one piece, they are fixed to the pillar, and meet in a miter with the other ſide.

The oak foliage is in one entire piece, and ſcrewed up to the bed-ſides, after the drapery valence is tacked to a rabbet made for that purpoſe.

Every

Every other particular muſt naturally occur to the workman, after what has already been ſaid on the other beds in this work. Upon the whole, though a bed of this kind is not likely to be executed according to this deſign, except under the munificence of a royal order, yet I am not without hopes that uſeful ideas may be gathered from it, and applied to beds of a more general kind.

Of the Dreſſing Commode. Plate XX.

WITH reſpect to the dreſſing part of this commode, it may be made either fixed faſt, or to be brought forward in the manner of a drawer, with leapers to keep it to its place. If it is made to be fixed faſt, the doors may be opened to form the knee hole.

The top which covers and encloſes the dreſſing part, ſlides down behind, in the manner deſcribed in page 407, to which I refer the reader; only obſerve, that in this top there are miters to fit the ſtraight moulding in front when the top is put down. A bottle of water, and a pot to receive it when dirty, can both be kept in the cupboard part.

The dreſſing-table below can require no explanation, except what relates to the ſize, which from front to back is

eighteen

eighteen inches, thirty-four the whole height, and two feet four the length of the front.

Of the Sideboard, with Vaſe Knife-caſes. Plate XXI.

THE pedeſtal parts of this ſideboard may be made ſeparate, and then ſcrewed to the ſideboard. The top extends the whole length, in one entire piece, and is ſcrewed down to the pedeſtals. The hollow plinths of the vaſes are worked in one length, and mitered round. The top of the plinth is then blocked on at the under ſide, and the vaſe part is made to ſcrew into it, ſo that the vaſes may occaſionally be taken off. A croſs band is meant to be mitered all round the hollow plinths, coming forward to the edge of the top; ſo that if the top be veneered, it will only require the length between the two plinths. Within the front is a tambour cupboard, which is both uſeful, and has a good effect in its appearance; almoſt any workman will know how to manage this, ſo that I need not explain it. The ornament behind is braſs, intended as a ſtay to ſilver plate, and has branches for three lights. The circle in the center may have a glaſs luſtre hung within it, as an ornament. For any other particular relative to ſideboards in general, ſee page 363, where the common principles of this uſeful piece of furniture are explained.

Of the Library Steps. Plate XXII.

THESE ſteps are conſiderably more ſimple than thoſe already deſcribed; and though not ſo generally uſeful, will come vaſtly cheaper. The upper flight of ſteps turn down upon the under ones, both of which riſe up and ſlide in as a drawer; after which a flap, which is ſhewn in the deſign, is turned up, and has the appearance of a drawer front. Obſerve, that the reſting poſt at the top folds down to the ſide of the ſteps by means of an iron joint. The horſe has green cloth under its feet, to prevent its ſcratching the top. The deſign ſhews that the two ſteps are connected together by hinges, ſo made as to clear the edge of the table-top; and alſo, that there is a ſliding board to which the under flight is hinged, which ſliding-board runs in a groove.

The length of the table is three feet ſix inches, its width twenty-two inches. The table is thirty inches high, the upper flight is thirty perpendicular, and the reſting-poſt thirty-three. This, and the other deſign for library ſteps, have obtained a patent; yet any part being materially altered, will evade the act, though the whole be nearly the ſame. Thoſe maſters, however, who do not think it worth their while to be at the trouble

of introducing any eſſential alteration in them may have theſe ſteps from Mr. Robert Campbell and Son, Mary-le-bone Street, London, with a ſufficient allowance for ſelling them again.

Of the Chamber Horſe.

THE upper figure ſhews the inſide when the leather is off, which conſiſts of five wainſcoat inch boards, clamped at the ends; to which are fixed ſtrong wire twiſted round a block in regular gradation, ſo that when the wire is compreſſed by the weight of thoſe who exerciſe, each turn of it may clear itſelf and fall within each other.

The top board is ſtuffed with hair as a chair ſeat, and the leather is fixed to each board with braſs nails, tacked all round. The leather at each end is cut in ſlits to give vent to the air, which would otherwiſe reſiſt the motion downwards.

The workman ſhould alſo obſerve, that a wooden or iron pin is fixed at each end of the middle board, for the purpoſe of guiding the whole ſeat as it plays up and down. This pin runs between the two upright pieces which are framed into the arms at each end, as the deſign ſhews.

The

The length of the horſe is twenty-nine inches, the width twenty, its height thirty-two. To the top of the foot board is eight inches, and to the board whereon the ſeat is fixed is thirteen.

Of the Corner Night Tables. Plate XXIII.

THAT on the right requires no explanation, except that the doors may be hinged to turn in, if it is thought moſt convenient.

The table on the left is intended to anſwer the purpoſe of a waſh-hand ſtand occaſionally. To anſwer this end the top part is framed together of itſelf, and fixed by an iron or ſtrong wooden pin, into the back corner of the lower part, which contains a ſocket, ſo that the top part can be turned to one ſide, as ſhewn in the deſign, or as much further as is neceſſary to clear the hole.

Obſerve alſo, that on the front is worked a groove, in which a pin paſſes that is fixed to the front of the bottom of the upper part, and prevents the top part from turning quite off from the bottom, which would endanger the pin on which the top part turns; it ſhould have caſtors at the brackets, that when the night

night table is wanted, it may be drawn a little forward from the corner of the room to give place for turning round the upper part. It ſhould be about thirty-four inches to the top of the baſon ſhelf. The height of the ſeat ſixteen inches and a half, and its other dimenſions are known from the plan. The bottom drawer may be made neat, and drawn out by means of a dovetail groove in the middle of the drawer, ~~and a~~ piece to fit it fixed acroſs the bottom of the carcaſe.

Of the Pulpit. Plate XXIV.

THE deſign of introducing a pulpit into this work was to afford ſome aſſiſtance to the cabinet-maker, who in the country is generally employed on ſuch occaſions. In erecting a pulpit of this kind, three particulars ought principally to be regarded. Firſt, the plan; ſecondly, the manner of conducting the ſteps and hand-rail round the column; and, laſtly, to fix the whole firm, ſo that it may not by ſhaking produce a diſagreeable ſenſation to the preacher.

The plan of this pulpit is a regular hexagon, which to me is the moſt beautiful and compact of any. One of its ſides is occupied by the door, and one for the back of the preacher, another to reſt his arm, and the remaining three for the cuſhion.

The plan of the ſteps is a circle, which is moſt convenient where there is a want of room. The plan ſhould be divided according to the number of ſteps neceſſary for attaining to a proper height, which in this caſe is twelve, as one, two, three, &c. in the plan.

A ſection ſhould then be drawn, and the height of the riſers adjuſted to the number of the ſteps, as in the ſection *a*, *b*, *c*, &c.

Draw the ſemi plan P, and divide the circumference into eight equal parts, as 1, 2, 3, 4, &c. becauſe, that in the plan there are ſo many ſteps contained in its ſemi. Draw from 1, 2, 3, 4, &c. lines perpendicular, and continue them to the uppermoſt ſtep. From *a*, the firſt ſtep, draw a line to *a* on the plan P. Do the ſame from *b* to *b*, *c* to *c*, and ſo of all the others, which will deſcribe the ſteps and riſers as they revolve on a cylinder. The face mould for the hand-rail, when it is cut out of the ſolid, is found as follows. See Plate XXX. Draw a quarter plan as there deſcribed, divide the chord line into any number of equal parts, as 1, 3, 5; from which raiſe perpendiculars to interſect the circumference; draw next the rake or pitch-board of the ſteps at Fig. R, by taking the breadth of the ſtep on the plan, and repeating it 1, 2, 3, 4; then take the

the height of four riſers, as from *x* to *y*, and draw the line *y* 4, which line will be the chord for the face mould; therefore take *y* 4, and divide it into ſix, as in the plan of the hand-rail. Take the perpendicular heights as 1 2, 3 4, and 5 6, of the plan, and transfer them to the correſpondent perpendiculars on the face mould, which will give points through which the curve is to paſs, to form the face mould, as the figure ſhews. Three of theſe lengths will be wanted to complete the hand-rail, including the ramp and knee.

Theſe hand-rails are however ſometimes glued up in thin pieces round a cylinder in one entire length, after which a croſs banding is put on the top, and rounded off. In this caſe a cylinder is formed in deal, and the line of the ſteps is traced out as deſcribed Plate XXIV. which is the guide for the thin mahogany to be bent round. In fixing the ſteps, I preſume it will be found the beſt method to mortice and dovetail the riſers of each ſtep into the pillar: this may be done by making the mortice as much wider than the breadth of the riſer as the dovetail is intended to be in depth, ſo that when the riſer is put into the mortice, it may be forced up to its place by a wedge driven in at the under edge of the riſer. By this means it will be impoſſible that the ſteps ſhould work when they are tongued and blocked together. The ſoffits of the ſteps are in the form of an ogee,

ogee, anſwerable to the brackets, and are fitted up ſeparately afterwards.

In fixing the pillar it muſt be noticed, that it is firſt tenoned into tranſverſe pieces of oak timber, which are ſunk a good depth into the ground, ſo that when the clay is beat in ſolidly about the pillar it cannot work; yet it is eaſy to conceive, that in the pulpit it will be liable to ſpring when the preacher is in it; to prevent which I have introduced a light ſmall column, ſituated in the center of the pulpit, and connected with it by a cove, on which the pulpit reſts. The ſound board is made as light as poſſible, which finiſhes in an octave cove at the top, and is fixed to the pillar by a ſtrong ſcrew and nut, together with a tenon, which is ſunk into the ſound board. The banniſters of the hand-rail may be ſtraight bars of braſs, made very light, dovetailed into the ends of the ſteps, and let into a plate of thin iron at top, which is ſcrewed to the under ſide of the hand-rail.

Obſerve, that on the left ſide of the plate is a ſcale of feet and inches, from which the various meaſurements may be taken.

N. B. Plates 25 and 27, 28 and 29, require no explanations; they are therefore omitted.

Of the Ladies' Work Tables. Plate XXVI.

THE table on the left is intended to afford conveniences for writing, by having a part of the top hinged in front to riſe up. This riſing top when it is let down locks into the frame, and ſecures the bag where the work is. The ſtandards on which the table frame reſts have tranſverſe pieces tenoned on, which ſcrew to the under ſide of the frame. The drapery which hides the work-bag is tacked to a rabbet at the under edge of the frame all round.

The deſign on the right is ſimply a work table; the upper frame, to which the top is hinged, is about two inches broad, made ſeparate. The pillar is fixed to the bottom of the bag, which is a round frame made of wainſcot, with a ſtretcher acroſs each way, for the purpoſe of fixing the pillar to it, and to ſtrengthen the frame. The upper frame, already mentioned, is connected with the lower one by ſmall upright pieces tenoned in, after which the bag is formed of ſilk, and tacked to each frame, and ornamented on the outſide with drapery.

Of the Drawing Table. Plate XXX.

THIS table will be found highly uſeful to ſuch as draw, it being deſigned from my own experience of what is neceſſary

for thoſe who practiſe this art. The top of this table is made to riſe by a double horſe, that the deſigner may ſtand if he pleaſe, or he may ſit, and have the top raiſed to any direction. As it is ſometimes neceſſary to copy from models or flower-pots, &c. a ſmall flap is made to draw out of the top, which may be raiſed by a little horſe to ſuit any direction that the top may be in, ſo that the model or flower-pot may ſtand level. The ſliders at each end are neceſſary for the inſtruments of drawing, and for a light to ſtand on. The long drawer holds paper, ſquare and broad, and thoſe drawers which form the knee hole are fitted up for colours.

Of the Drawing Room. Plate XXXI. and XXXII.

WITH reſpect to the ſection, it is only neceſſary to obſerve, that the pier table under the glaſs is richly ornamented in gold. The top is marble, and alſo the ſhelf at each end; the back of it is compoſed of three pannels of glaſs, the Chineſe figure ſitting on a cuſhion is metal and painted. The candle branches are gilt metal, the pannels painted in the ſtyle of the Chineſe; the whole producing a brilliant effect.

The view, Plate XXXII. contains an otomon, or long ſeat, extending the whole width of the room, and returning at each

end about five feet. The Chineſe columns are on the front of this ſeat, and mark out its boundaries. The upholſtery work is very richly executed in figured ſatin, with extremely rich borders, all worked to ſuit the ſtyle of the room. Within this otomon are two grand tripod candle-ſtands, with heating urns at the top, that the ſeat may be kept in a proper temperature in cold weather. On the front of the otomon before the columns are two cenſers containing perfumes, by which an agreeable ſmell may be diffuſed to every part of the room, preventing that of a contrary nature, which is the conſequence of lighting a number of candles.

The chimney-piece is rich, adorned with a valuable time-piece, and two lights ſupported by two Chineſe figures; on each ſide of the fire-place is alſo a Chineſe figure, anſwerable to thoſe which ſupport a table on the oppoſite ſide, under which is ſeated a Chineſe figure. Over each table, the fire-place, and in the center of the otomon, is a glaſs, which by their reflections greatly enliven the whole. The ſubjects painted on the pannels of each wall are Chineſe views, and little ſcenes. The carpet is worked in one entire piece, with a border round it, and the whole in effect, though it may appear extravagant to a vulgar eye, is but ſuitable to the dignity of the proprietor.

N. B. In

N. B. In addition to what has been ſaid on perſpective in the firſt work, I would here annex a few remarks on taking the geometrical or original meaſurements of a piece of furniture drawn in perſpective, ſuppoſed to be deſtitute of any lines or ſcales.

In Plate XXX. is therefore inſerted a view of a bookcaſe, figure K, which the reader muſt imagine to be without any lines except thoſe which form the outline of the piece. It muſt, however, be premiſed, that a workman is acquainted with the proportion of ſome one or other of its parts, without which nothing can be done or aſcertained. He muſt alſo be acquainted with ſo much of perſpective as to know that a line paſſing through the diagonal of any ſquare, if produced, cuts the horizontal line in the point of diſtance. Theſe being known, proceed firſt to find the horizontal or vaniſhing line by producing *c d*, the top of, and *f r*, the bottom of the under part, till they meet in a point, as at *s*, which will be the point of ſight; through *s* draw a line parallel to the front of the bookcaſe, which will be the horizontal line ſought for. From the point of ſight draw at random lines forward from *p*, and *e*, or any other point that may be neceſſary. Next find out the point of diſtance, without which the depth of the ends cannot be known: in order to this, the workman muſt recollect that the brackets are always

always as long at the ends as on the front, and that therefore they form a ſquare block; wherefore take 4 *f*, and place it from *f* to *g*, and from *g* to *h*, the end bracket will be the diagonal of a ſquare, whoſe ſide is 4 *f*; produce the line *g h*, which will cut the horizon at D; the diſtance, as the line on the leg of the gouty ſtool, paſſes to the diſtance which is out of the plate. Laſtly; from D draw lines forward through *r* and 10, or any other part, till they cut the front line, as at *t w*, by which will be diſcovered the proportion that the ends bear with the front, and how much the lower part projects before the bookcaſe. Now if there be a ſcale of the front already to the deſign, then the whole can be determined; for by taking the compaſſes extended to a foot, and repeating it on the perpendicular line from *a* to *b*, the height of the doors are known, and by the ſame rule the height of the pediment from *l* to *m*. Then if the ſame compaſs be applied from *f* to *w*, the depth of the lower part, it will be found vaſtly out of proportion with the front, which I have done on purpoſe, to ſhew that by a compariſon of this ſort the errors of a deſign in point of perſpective may be diſcovered. If, however, there be no ſcale to the deſign, then it will be neceſſary to aſſign a certain portion for a foot, as near as we can judge, by conſidering the common length of a bracket, from *f* to 4, which in general is about four and a half or four inches, which repeated three times, finds a foot, as in this caſe, and then

it appears that the front is four feet long, and better than four feet high, that the doors are five feet nine high, and ſo of the reſt. But if there be no bracket, any other part may be taken whoſe meaſure is known, as the partition of a drawer, which is generally ſeven eighths thick, the height of a ſlider, about thirty-two inches, or the depth of a ſecretary drawer, about ten inches. The uſefulneſs of this method is not confined to pieces of furniture, but may be applied to any kind of regular perſpective.

END OF THE APPENDIX.

An Account of the PLATES in the APPENDIX, and the Pages they face.

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AN

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AN ACCOMPANIMENT, &c.

Inſtructions for Drawing Ornaments.

As a proficiency in the art of drawing ornaments depends chiefly on the habit of copying and the natural turn of genius in this way, a few hints only are neceſſary for the aſſiſtance of the learner.

Some inſtructions, however, are certainly neceſſary, as appears from the frequent applications that are made to maſters for their information. And though no written inſtructions can fully ſupply all that may be derived from a maſter *, yet ſuch directions may be given, in letter-preſs, as greatly to facilitate the attainment of this uſeful branch of drawing without a maſter's help.

The principal art of every branch of drawing is included in the diſpoſition of a few ſimple lines of but two different ſpecies,

* One very material advantage derived from a maſter is, that the pupil ſees how he practiſes, by which he may acquire his manner and ſtyle.

the

the right line and the curve. Of theſe two are compoſed all that infinite variety of ſhapes that we are able to ſee and conceive.

I will, therefore, propoſe to the learner, firſt to begin with drawing, by the hand, right lines a tolerable length parallel to ~~each other in all~~ directions; firſt, inclined to the right, as approaching neareſt to the art of writing; ſecondly, perpendicular; thirdly, inclined to the left; and laſtly, horizontal and at right angles with thoſe perpendiculars, and paſſing through their center. A proficiency in this is certainly the firſt ſtep in drawing, and is not ſo eaſily attained as may be imagined.

Secondly, let the learner then proceed to draw by the hand a circle, as large as poſſibly he can without moving the wriſt. And it will be proper for the learner to obſerve, that in being able to draw a circle by the hand and eye he thereby draws curve lines in all poſſible poſitions, as perpendicular, inclined to the right and left, and horizontal. In addition to this practice it will be neceſſary to draw one circle concentric with another; that is, as when two or more circles of different diameters are drawn from one center. This becomes uſeful when any thing is to be deſcribed in the ſhape of volutes, as the running foliage frequently introduced in friezes and pilaſters. What has here been ſaid of the circle will alſo apply to the practice of drawing an

ellipſis

ellipſis by hand. An ellipſis may be conſidered as a curve conſiſting of a number of ſegments of circles compound, whoſe radii differ in length. Of this kind of curve are many of the turns in ornament, and therefore the practice of drawing them will be found worthy the attention of the learner. To practiſe as has been deſcribed I conſider as indiſpenſably requiſite to a ready and perfect attainment in the art of drawing ornaments; and ought particularly to be recommended to youth, as a help to their writing any kind of hand, or drawing the Roman letters.

The learner who is advanced in years will not, perhaps, ſubmit to this kind of teaching: but if he cannot already draw right lines, of ſome length, parallel in all poſitions, and a circle tolerably near by the eye, he ought not to be above learning it, becauſe the time that is ſpent in this, will be deducted in future by a more ſpeedy progreſs in the art of drawing ornaments. And however this may be thought of by ſome as a thing of no merit, yet we will venture to affirm, that the hand of a real maſter may be certainly diſtinguiſhed by the manner of drawing theſe.

Of Copying Ornaments. Plate I.

SUPPOSE C to be the example to copy from. Take a black-lead pencil, and draw at B the principal curve-line at the bottom very faint *. Then proceed to form a rude ſketch of the out-line, obſerving carefully each projecting part of C, that a ſufficient breadth or ſpace may be taken within the out-line, in which may be formed all the diſtinct parts of B, without reducing their proportion.

Upon this proceſs correctneſs and diſpatch very much depend. Therefore, if upon the firſt attempt of this there ſhould appear any defect, it will be beſt to take out the lines with the India rubber, and make them perfect.

A carver or ſculptor proceeds upon this principle until merely the maſſive parts are made out; and it is well known that thoſe of the greateſt ſkill in theſe profeſſions are always employed in this part of carving and ſculpture.

After having done this, proceed to give the diſtinct forms of each leaf and roſe in faint touches, that if there ſhould be any cauſe for alteration it may be more eaſily effected. The

* To handle a pencil is, in many caſes of drawing, different from the manner of holding a pen. In handling a pen, the ends of the fourth and fifth fingers reſt on the paper; but in managing a pencil, the hand is turned over more to the right, and reſts on the knuckles of the little finger.

learner ſhould, in doing this, carefully obſerve and touch the fibres of each leaf, and give the proper lead to each ſtem, ſo that they do not cut each other.

Laſtly, take a view of the whole, and conſider in what point the light is to ſtrike on the ornament; and on that edge of the leaves and roſes oppoſite to it, retouch and ſtrengthen the outline in ſuch a way as to give relief and effect to the whole, even upon ſuppoſition that the drawing is to remain a mere outline.

Of Shading Ornaments.

If the ornament is to be ſhaded with Indian ink, mix ſome of it thin and clear, and take a crow-quill pen, or fine camel-hair pencil, and touch the outlines very faintly, ſo as ſcarcely to be ſeen on the light edges of the ornament; becauſe in nature there is, in reality, no outline on the light ſides of objects, eſpecially if the ſun is ſuppoſed to ſhine on them. After this, touch the ſtronger parts of each ſtem and fibre, that they may not be loſt when the pencil marks are expunged.

Having cleaned your drawing, take a large camel-hair pencil, and dip it till it flow freely with Indian ink very thin and clear. And obſerve, that if the ink do not work with freedom on a piece of waſte paper, which ſhould be kept for the purpoſe

pofe of trying the pencils, the brufh in this ftate ought not to be applied, but fhould again be well worked in the thin Indian ink, fo that it work eafy, without leaving white fpots on the paper. In this ftate apply the pencil to the ornament, and give a general tint to thofe parts fuppofed to be all in fhadow; at the fame time a partial tint may be given to the objects partly in the light. This firft courfe of fhadowing is the great bafis of all real effect; for if the maffes of light and fhadow are not properly parted, but confounded, the drawing will look heavy, intelligible, and boyifh.

When the drawing is properly dry, the laft tints are to be given with great delicacy and care, left the whole be over done, and, as it were, tormented with harfh dabs. The intention of this laft tint is only to give reflected lights to thofe parts which lie in the mafs of fhadow, and fharpnefs to the partial fhadows directly oppofed to the light.

It is natural for the learner, in giving the laft tint, to think of thickening his ink; but this muft be avoided, as dangerous to the effect of ornament; for if the ink at firft ufed be again repeated on the former tint, it will give fufficient colour, except the openings of the fibres, which may be touched with ftronger ink.

Effect to ornament may alſo be given by a pen, in imitation of etching; which, if well executed, is more pleaſing in ornament than Indian ink.

Italian chalk is ſometimes uſed along with a black-lead pencil, which may be done with extremely good effect.

The learner, being furniſhed with theſe inſtructions, may proceed in the ſame way with the reſt of the ſpecimens in foliage~~, the~~ principal variety of which is here exhibited.

K, is the thiſtle leaf, ſharply pointed and irregular.

G, is the Roman-leaf, round and maſſy.

F, the parſley leaf, light and rather ſharp pointed.

E, the roſe leaf, formed into groups.

D, The oak-leaf, broad and maſſy, ſcolloped on the edge, with ſmall partings.

A, Is a fancy leaf, rather ſharp, with large partings.

C, roſes and leaves alternately.

With theſe ſpecimens the learner ought to be well acquainted, before he proceed to draw running ornaments, that he may give ſufficient variety in each turn.

The regular leaves, in Plate XI, ſhould alſo be copied, as they are much in uſe in carving and japanning.

Next, proceed with the borders in Plate III, which are intended for japanning or inlaying; and ſo on with any other of the Plates, as Plate V. VII. and IV. as they may appear moſt ſuitable to his abilities in drawing; obſerving in all caſes to make a very light pencil-ſketch of the whole deſign, before any thing is attempted to be finiſhed.

Of Qualifications neceſſary for Compoſition.

To qualify the learner for compoſition, he ought, in ſome meaſure, to be acquainted with the proportions of human figures, eſpecially thoſe taken from the antiques. My very limited plan in publiſhing theſe ornaments affords me no opportunity of doing any thing in this way by example. I will, however, give a few hints reſpecting their proportions, for the aſſiſtance of thoſe who have no opportunity of conſulting the beſt maſters.

The

The proportion of the male figure, according to Mr. Brifbane's Anatomy, from Albinus, will be near enough, as follows: If the perpendicular height of the intended figure be divided into ten equal parts, and one of thefe parts into four, the proportions will run thus with refpect to length: the head, from the crown to the chin, one tenth and one fourth; the neck rather more than one third of the head; from the fummit of the fhoulders to the bottom of the belly, three tenths; from the bottom of the belly to the center of the knee-joints, two tenths and one half; and the fame from the center of the knee-joints to the bottom of the feet. Obferve, the height of the hips are fix tenths and one third from the ground, and the length of the arm four tenths and rather more than one half.

In thicknefs as follows.—Over the fhoulders, two tenths and one fourth; over the hips, one tenth and rather more than three fourths; over the thick part of the thigh, one tenth; the fmall part, near two thirds. Thefe principal parts being attended to, the reft will follow of courfe, by practifing a little upon the different parts of the body from examples. When the proportion of any male figure is to be proved, take the thicknefs of the thigh as one tenth of its height, and by remembering the above proportions any figure may be examined. By thefe proportions I have examined a figure engraved from the famous Raphael, an Italian painter, and found them to agree

 exactly.

exactly. In respect to the female figure there is some difference in the proportions; the whole is more slender and elegant; the shoulders are not so broad; the trunk or body is shorter; the hips broader, and in proportion higher from the ground; and the muscular parts are not so strong and prominent. As female figures are frequently interspersed in the composing of ornaments, it is proper to observe, that much depends on the management of the drapery with which they are clothed. It ought to hang with freedom and ease, and in some parts to lie close, so as to discover some of the principal shapes. To effect this, it is best, first, to draw the figure by the pencil as if entirely destitute of drapery, and afterwards to lay the drapery gently over with Indian ink, or colour, as may be required; so that the lines which marked out the parts of the body, now covered, may be expunged. This method gives true effect to the drapery, by enabling us to determine where there ought to be strong, where slight, and where no folds at all. On the prominent parts of the body there are no folds in the drapery; but after having just passed over these, the folds commence in tender marks, and increase into strong folds where the drapery is detached from the body.

In examining Cipriani's figures, I find, that if the assigned height of the female figure be divided into ten equal parts, from the ground to the waist, where the drapery is sometimes tied round,

round, is ſeven tenths; from the waiſt to the top of the ſhoulders, one tenth and an half; the neck a quarter, the head one tenth and a quarter, and over the ſhoulders rather more than two tenths.

As boys or cupids are frequently introduced in ornaments, it is proper that the learner ſhould take notice of their proportions and general appearance, as different from thoſe already deſcribed. Cipriani's boys are of the following proportions:—If the aſſigned height be, as before, divided into ten equal parts, the head will be full two tenths in height; the neck very ſhort; from the top of the ſhoulders to the bottom of the belly, four tenths; from the bottom of the belly to the knee-joint, full two tenths; and from the knee to the ground, bare two tenths; the arms, when hanging perpendicular, come not quite to the middle of the thigh; the breadth of the ſhoulders not quite three tenths; and, laſtly, the thick part of the thigh, one tenth and an half, which will of courſe give the proportion of the leg. The learner ſhould obſerve the general caſt of theſe figures; the head is large and round; the neck ſcarcely diſtinguiſhable between the head and ſhoulders; no joints appearing in the arms or legs ſcarcely; the ankle covered with fleſh, and the whole leg thick and maſſy.

But, beſide the human figures, there are others of an imaginary

ginary kind employed by the antiques in their decorations. Theſe are ſtill, and ever will be retained in ornaments leſs or more. The moſt taſty of theſe were ſelected by Raphael, and painted by his pupils on the walls and ceilings of the Vatican Library at Rome, and which are handed down to us, by the Italians, in maſterly engravings; which, in the courſe of this work, I have conſulted, and from which I have extracted ſome of my ideas, as well as from ſome French works.

In the Vatican are figures whoſe upper part is female, and the lower of foliage entwiſting round. Other female figures have their lower part of a fiſh, and ſome of a greyhound. Others ſhew only a human head, with foliage ſpringing from it in different forms, anſwering for wings, and for a covering of the lower parts. In it, we ſee ſometimes a dolphin fiſh with an ornamented tail; a lion's head and an eagle's leg and talons brought into a ſmooth outline by the help of foliage: at other times a tiger's head and paw formed in the ſame manner. Some, again, are partly a horſe with wings and two fore legs, and partly the tail of a fiſh; all which are now a nameleſs generation, but once the offspring, I preſume, of the ancient metamorphoſes, either what they termed real or apparent.

Beſides theſe, are to be ſeen, in the above work, the ſphinx, a figure of much fame amongſt the ancients, whoſe upper part

is

is a woman's head and breaſts, and the wings of a bird; the lower part the body of a dog, and the claws of a lion. This monſter is ſaid to be the production of two deities, and ſent as a ſcourge to the Thebans. Its buſineſs, on a mountain at Thebes, was to propoſe dark queſtions to paſſengers, and if not anſwered to devour them. It is ſaid that the Egyptians uſed the ſphinx as a ſymbol of religion, on account of the myſteries which it was capable of interpreting. The Romans therefore placed it on the porches of their temples.

The centaur, partly a man, and partly a horſe, uſed as one of the ſigns of the zodiac, in which the man part is repreſented ſhooting with a bow.

This being is alſo ſaid to be the offspring of a deity in conjunction with a cloud. They inhabited Theſſaly; and, engaging in hoſtilities with the bow, were vanquiſhed by Theſeus. As they ſeem to have been a rebellious race, they may be introduced into ſuch ſubjects as are intended to ſhew the odium of ſuch conduct.

The griffon is another fabulous being, exiſting only in the vain imaginations of the ancient heathen poets, as do the two former. They repreſent it partly an eagle, and partly a lion; that is, the lower part of it. They ſuppoſe it to watch over golden

golden mines and hid treafures. It was confecrated to the fun, whofe chariot was drawn by a number of them. And thefe, if you pleafe, may be introduced into fubjects intended to reprefent covetoufnefs; or they may be placed over cabinets where treafure is kept.

It will be proper that the learner fhould ftudy to compofe thefe, if he intends being a proficient in ornaments. In fhort, to be fully qualified for ornamental decorations, is to be acquainted with every branch of drawing.

And, further, to compofe to much purpofe, it requires to have a general infight into works of this nature, and particularly to fee the painted walls in noblemen's houfes, in many of which the art is exhibited to its utmoft perfection; and in none more fo than in the printed and painted filks executed of late by Mr. Eckhardt, at his manufactury at Chelfea, adapted for the purpofe of ornamenting pannels, and the walls of the moft elegant and noble houfes.

Of Compofition.

After the ideas of the pupil are extenfively furnifhed in the manner now defcribed, it will be proper to begin with fome fmall ground to compofe on, fuch as the frieze of a cornice; and

and to confider its fituation with the eye, whether it be intended to be much above it, fo that the parts of the ornaments may fuit the fuppofed diftance of the eye from it. It is of no effect to put a number of fmall ornaments in, to be viewed at a great diftance. In this cafe the parts fhould be fimple, entire, and rather maffy, to produce a proper effect. If the frieze be near the eye, it may then be divided into fmaller parts; but to crowd it in any cafe ought ftudioufly to be avoided. And obferve, the tablets of friezes ought to be diverfe to the other ornaments in it.

I would then recommend to compofe on the ground-work of a pilafter not very broad; for it is to be obferved, that the difficulty increafes in proportion to the width, more than in the height of a ground-work. The ornaments in a pilafter or pannel is confidered as growing upwards, and therefore it ought to take its rife from fomething principal at the bafe, and grow rather lighter towards the top, as in every inftance is fhewn in nature. But this does not confine the compofer to fuppofe that every thing is to be faftened or tied to each other as in ftrict nature, for this would fometimes be the fource of heavinefs in ornaments; nor do I fee it practifed in the Vatican, or by any of the beft artifts in this way. But certain it is, that the beft compofitions are thofe which keep the parts moft connected in one entire piece. The more we attain to this, whilft we avoid a

heavy repetition of the ſame parts, the nearer do we arrive at perfection in this art.

The ornaments of a pilaſter ought to fill regularly on each ſide, and not to leave much naked ground. And eſpecially we ought to obſerve, not to have the ground alternately crowded and naked. If we begin in an open ſtyle, leaving much naked ground, this ſhould be continued uniformly all the way up, and, if any thing, only to grow more open at the ſummit. The laws of harmony in every art, where time, motion, and ſpace are obſerved, require this.

If the ſurface to be ornamented be horizontal, and is liable to be viewed alike in all points, as in a ceiling, the ſubject ſhould be regular, and formed into pannels and groups, ſurrounded with foliage of the ſame kind and form on all ſides. Nature exemplifies a regularity in moſt flowers, and in other things that grow horizontal.

Laſtly, to compoſe ornaments for a large upright pannel, as in rooms, is by far the moſt difficult taſk in this art. Here it is required that the artiſt collect and arrange all his ideas; and thoſe ſcattered fragments which exiſt in his mind through long and repeated obſervation on the works of the beſt maſters, muſt now be collected to form an entire whole, by a general concourſe

or aſſemblage of every branch of drawing. In this large field, architecture, perſpective, figures, landſcape, foliage, and fruit, may vie with each other, and ſhew the maſter's ſkill.

Attempts of this nature may be made by the learner, and with ſucceſs, though he fall vaſtly ſhort of a perfect diſplay of all theſe different branches of drawing; for it is to be obſerved, that the rule for judging in works of this nature is not to look for eminence in each and every diſtinct branch, but to diſcern fine taſte and juſtneſs of compoſition in the whole.

In compoſitions of this nature ſomething ſpreading and maſſy ought to be at the bottom of the pannel, except the ornament be only intended to occupy the center, in which caſe the principal part of the ornament ſhould be in the middle; but where the entire pannel is to be filled up, we ſhould begin as above, that there may be an opportunity of giving breadth to the foliage, for the purpoſe of filling up the ground regularly from one beginning only, for two deſigns muſt not be entwined with each other in the manner of cyphers. This deſtroys the beauty of ſimplicity, which conſiſts in fewneſs of parts, and entireneſs of forms, without which all is a jumble.

This obſervation will teach us to avoid that kind of croſſing and cutting each other, ſomething like the rigging of a ſhip,

which may be obſerved in ſome ornaments, even of French production as well as Engliſh. A practice this, which always denotes bad compoſition, and a barrenneſs of thought. It is done with a deſign to enrich, but it only turns out to be a filling up to the prejudice of the whole. The learner muſt therefore ſtudy to enrich by a variety of thought ſpringing from ſomething, yet without interfering with each other.

He ſhould alſo be careful in avoiding the appearance of ſtraight lines continued from bottom to top, which is formal and bad. Some continuance of a right line is beautiful; but it ought quickly to be broken in theſe compoſitions, whether perpendicular or horizontal.

Obſerve breadth in the parts, ſhun niggling and meanneſs, and ſtick at nothing that will have a comely and pleaſant appearance.

An Explanation of the Plates.

PLATE II. are chair legs. That on the left is intended for japanning, and is formed ſquare. The other two on the right are turned, carved, and gilt.

Obſerve,

Obſerve, the plinth of the center foot is left ſquare, and pannelled out.

If the leg on the right be thought to have too much work, the huſks in the flutes and the drapery on the plinth may be omitted.

Plate III. Borders for japanning or inlaying.

Plate IV. Ornament for a pannel. The whole ſprings from a ſpreading leaf at the bottom, from which a ſerpent attempts to come at the doves on the fruit. In the center is a temple not dedicated to the intereſts of the cupids, for which reaſon they are burning it with their torches. The figure on the top of the column, in reſentment, means to pelt them with ſtones; and the geniuſes above are pouring down water to quench the flames. The owls are emblematic of the night, at which ſeaſon theſe miſchiefs are generally carried on. The other deſigns in this plate require no remark.

Plate V. Ornament for a tablet, intended for painting on a grey or blue ground, as beſt calculated to throw forward the figure and fruit.

In the cornices, the acorns in one, and huſk in the other,

are

are turned with a pin; by which they are fixed into the large projecting ſquare.

I would adviſe to work the upper part of the cornice ſeparate, by which means the acorns will be more eaſily fixed. The frieze may be carved, painted, or inlaid.

Plate VI. Deſigns for Bed-pillars.

No. 1 and 2 are to be painted; No. 3 carved in mahogany; and No. 4 and 5 are intended for rich ſtate-beds, carved in white and gold. The ſcale of feet and inches at the bottom will give the heights, and other proportions.

The pateras which cover the ſcrew heads are on looſe pannels let into the pillars, and which ſettle down into a groove at the bottom, by which means they are kept in their place, and eaſily taken out.

Plate VII. Ornaments for the center of a pembroke and pier table needs no explanation.

Plate VIII. Of chair ſplads.

No. 1, 2, 3, and 6, are intended for parlour chairs, carved in mahogany.

No.

No. 3 and 4 are for painted chairs. Obſerve, the curve lines which come from the top rail at No. 2 and 6 are intended to ſhew where the outſide ſplads in a complete back will come in, anſwerable to No. 4.

Plate IX. Of toes and knees for pier and card tables.

No. 1, 3, 5, are meant for pier tables, the ornaments of which are intended to be carved and gilt.

No. 2, 4, 6, are for card tables, with ſtringing and pannels let in.

Plate X. Of chair elbows, with part of the ſeat, together with ſplads for chair backs.

The ſplads are all intended for japanning, except No. 4, which may be worked in mahogany.

The elbows are meant chiefly to be carved and gilt; but the mere outlines of any of them will ſerve as patterns either for painted or mahogany chairs, by leaving out the ornaments for the mahogany, and retaining ſome of them, or even all of them may be adapted for painting.

It may be proper to obferve, that as high as the ftuffing of the feat a rabbet fhould be left on the ftump to ftuff againft; which is eafily done, as the ftump is made fmaller above the rail. The cufhions on the arms are formed by cutting a rabbet in the arm, or leaving the wood a little above the furface. Some, however, bring the rabbet fquare down at each end, covering the wood entirely, except a fillet, which is left at the bottom and continues round the cufhion.

Plate XI. Ornament for a tablet intended for a painting, but which might be enlarged very well.

The fubject is a faint moonlight fcene, reprefenting Diana in a vifit to Endymion; who, as the ftory goes, having offended Juno, was condemned by Jupiter to a thirty years fleep. It may not be improper to advertife fome, that thefe, with a thoufand other of the fame kind of ftories, are merely the fabrications of ancient poets and idolaters, forming to themfelves innumerable gods, according to their vain imaginations, and which now, only ferve to try the painter's fkill in decorating our walls. And in oppofition to thefe vanities, I cannot well omit whifpering into the ear of the reader, that "To us there is but one God, the Father, of whom are all things." 1 Cor. viii. 6.

Plate

Plate XII. Cornices for Windows.

The one acroſs the plate is intended for japanning, the upper one for carving and gilding, and the two under ones may be either carved or japanned.

The circular ends of this cornice are ſometimes formed of a faintiſh curve, and ſometimes of a quick one. When they are of a faint ſweep, they ought to be made ſomewhat longer at each end than the outſide of the architraves, to give place to the curtain rods, ſo that they may be brought ſufficiently forward on the lath, and not leave too great a vacancy between the rod and cornice leaves, otherwiſe the lath will be ſeen when there is no drapery. In making theſe cornices, it is beſt to plough and tongue in the leaves to the under ſide of the facia of the cornice. The ends may be formed by gluing blocks of deal one on another till they come nearly to the ſweep; and after having formed the outſide curve, I would then adviſe to gage on for the plough-groove for the leaves, before the wood in the inſide is brought to its form, that the pieces for the leaves may be put in without ſplitting off the groove. After theſe are well dried, then the ſuperfluous wood on the inſide can be taken away.

When the cornices are made at each end with a quick curve, the whole is firſt worked in ſtraight mouldings, and mitered together at each end, the ſame as if intended to be ſquare, according to the old faſhion. When they are glued in the miters, get out blocks of deal, about two inches and an half ſquare, and cut them down anglewiſe, and let their length be equal to the width of the cornice and length of the leaves.

After theſe blockings are dry, cut off as much of the old miter as is ſufficient to form the curve, and work the mouldings again by hand; and obſerve, that as the block was left long enough, the curved leaf is intended to reſt againſt it, by which it will be much ſtrengthened.

The cornices made thus, with a quick curve, needs not be made longer than uſual, becauſe the quick curve admits the rod to come forward more eaſily than the other.

Plate XIII. Pilaſters for Commodes.

These may be painted, inlaid, or gilt in gold behind glaſs, and the glaſs being then beded in the pilaſter, it is ſecure, and has a good effect.

Plate

Plate XIV. Chair Legs.

The center leg is worked ſquare; that on the right is octagon, except the vaſe at the knee; and that on the left, round. Theſe may, in the view of ſome, be thought too full of work; but the ſkilful workman will eaſily ſee how to reduce their richneſs, and accommodate them to his purpoſe.

FINIS.